UNCLASSIFIED

Department of Defense Budget for Fiscal Year 1997

March 1996

RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSE-WIDE

Volume 1 - Defense Advanced Research Projects Agency

SUMMARY TABLE OF CONTENTS

THIS PAGE INTENTIONALLY LEFT BLANK

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

Table of Contents

THIS PAGE INTENTIONALLY LEFT BLANK

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

THIS PAGE INTENTIONALLY LEFT BLANK

Advanced Research Projects Agcy
FY 1997 R D T & E Program

Exhibit R-1

Appropriation: 0400 D Research Development Test & Eval Defwide

Date: 12 MAR 1996

Line No	Program Element Number	Item	Act	Thousands of Dollars FY 1995	FY 1996	FY 1997	Sec
2	0601101E	Defense Research Sciences	1	85,069	77,600	74,923	U
	Basic Research			85,069	77,600	74,923	
11	0602301E	Computing Systems and Communications Technology	2	376,490	363,038	346,957	U
13	0602702E	Tactical Technology	2	118,755	127,205	117,944	U
14	0602708E	Integrated Command and Control Technology	2	79,375	48,342	45,000	U
15	0602712E	Materials and Electronics Technology	2	260,979	235,159	218,539	U
	Applied Research			835,599	773,744	728,440	
27	0603226E	Experimental Evaluation of Major Innovative	3	581,818	582,616	635,553	U
30	0603569E	Advanced Submarine Technology	3	31,400	31,687		U
32	0603570E	Defense Reinvestment	3	208,067	185,741		U
41	0603739E	Advanced Electronics Technologies	3	383,459	393,144	332,100	U
42	0603744E	Advanced Simulation	3	27,910	4,887		U
43	0603745E	Semiconductor Manufacturing Technology	3	88,327	37,296		U
44	0603746E	Maritime Technology	3	38,780	47,196	37,408	U
45	0603747E	Electric Vehicles	3	14,170	14,694		U
51	0603800E	Joint Advanced Strike Technology - Dem/Val	3		29,557	78,400	U
52	0603805E	Dual Use Applications Programs	3			250,000	U
54	0603889E	Counterdrug RDT&E Projects	3	38,970			U
	Advanced Technology Development			1,412,901	1,326,818	1,333,461	

Advanced Research Projects Agcy
FY 1997 R D T & E Program

Exhibit R-1

Appropriation: 0400 D Research Development Test & Eval Defwide

Date: 12 MAR 1996

Line No	Program Element Number	Item	Act	Thousands of Dollars FY 1995	FY 1996	FY 1997	Sec
87	0605114E	BLACK LIGHT	6	4,725	4,623	4,730	U
99	0605898E	Management Headquarters (Research and Development	6	29,921	34,099	36,369	U
100	0909900E	Financing for Expired Account Adjustments	6	3,726			U
		RDT&E Management Support		38,372	38,722	41,099	
Total		Advanced Research Projects Agcy		2,371,941	2,216,884	2,177,923	

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: March 1996
APPROPRIATION/BUDGET ACTIVITY: RDT&E, Defensewide; BA 1 Basic Research	R-1 ITEM NOMENCLATURE: Defense Research Sciences, PE 0601101E

COST (In Thousands)	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Defense Research Sciences	**84,572**	**77,600**	**74,923**	**74,536**	**76,000**	**77,500**	**77,386**	**Continuing**	**Continuing**
Information Sciences CCS-02	23,072	22,103	23,539	23,005	22,900	25,400	24,900	Continuing	Continuing
Electronic Sciences ES-01	34,401	37,912	39,684	40,078	34,409	34,478	32,533	Continuing	Continuing
Materials Sciences MS-01	27,098	17,585	11,700	11,453	18,691	17,622	19,953	Continuing	Continuing

(U) **Mission Description**: The Defense Research Sciences program element is budgeted in the Basic Research Budget Activity because it provides the technical foundation for long-term improvements through the discovery of new phenomena and the exploration of the potential of such phenomena for military, national security and commercial applications. It supports the scientific study and experimentation that is the basis for more advanced knowledge and understanding in information, electronic and materials sciences.

(U) The Information Sciences project supports basic scientific study and experimentation in software technology, intelligent systems technology, human-computer interaction technology, facets of microelectronic sciences, and varied aspects of high performance computing.

(U) The Electronic Sciences project explores and demonstrates electronic and optoelectronic device, circuit, and processing concepts that will provide: (1) new technical options for future electronic and optical systems used in information transmission, gathering and processing; and (2) a substantial increase in performance and cost reduction per function.

(U) The Materials Sciences project is concerned with the development and exploitation of: development of high power/energy density electrochemical power sources (batteries and fuel cells); bioremediation tools for cost effective in situ toxic waste conversion; waste source reduction for DoD-relevant manufacturing processes. In addition, research is focused on basic concepts for development of magneto-resistive materials for use in radiation hardened memories, and development of forward combat casualty care medical technologies.

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 1 Basic Research	R-1 ITEM NOMENCLATURE Defense Research Sciences, PE 0601101E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Information Sciences CCS-02	23,072	22,103	23,539	23,005	22,900	25,400	24,900	Continuing	Continuing

(U) **Mission Description:** This project supports the basic scientific study and experimentation that is the basis for more advanced knowledge and understanding in information sciences technology areas such as software foundations and environments, intelligent systems, human computer interface, language technology, microelectronic science, and high performance computing related to long-term national security requirements.

(U) In the area of software technology: advanced concepts are developed for methods and tools to produce high assurance software; language concepts that facilitate the rapid specification and evolution of systems; and techniques to manage shared complex structured data objects in larger heterogeneous, distributed information systems. The intelligent systems technology focus is on advanced techniques for knowledge representation, reasoning, and machine learning, which enables computer understanding of spoken and written language and images. Also included is advanced methods for planning, scheduling, and resource allocation. The focus in the human computer interaction technology area is design methods and enabling technology for more natural interaction between people and computers. Lastly, the high performance computing (HPC) focus is on science generated concepts and methods for validating and verifying design components, and unique approaches to rapidly develop high performance libraries across multiple HPC architectures.

(U) **Program Accomplishments and Plans:**

(U) FY 1995 Accomplishments:

- Experimentally evaluated advanced information processing methods in spoken language understanding, written language understanding, and automated planning systems. ($5.0M)
- Developed initial tool kits for interactive, dialogue-based human computer interaction and demonstrate them in a clinical environment. ($5.5M)
- Developed initial language-based methods for image understanding, high assurance, software engineering system composition and experimentally evaluated process model approaches for prototyping large-scale software environments. ($6.9M)
- Experimentally evaluated library research that supports multiple parallel architectures. ($1.8M)
- Demonstrated health information network using South Florida Clinic. ($.9M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 1 Basic Research	R-1 ITEM NOMENCLATURE Defense Research Sciences, PE 0601101E, Project CCS-02

- Developed initial planning and decision aids prototypes for heterogeneous, distributed software system architectures and tools to support construction and maintenance of advanced intelligent systems. ($3.0M)

(U) FY 1996 Program:

- Refine and enhance benchmark problems, metrics, and test data sets and conduct experimental evaluations involving multiple intelligent systems and software engineering foundations technologies, utilizing knowledge acquisition. ($5.7M)
- Enhance advanced information processing methods in spoken language understanding, written language understanding and automated planning systems. ($4.7M)
- Experimentally evaluate tool kits for interactive, dialogue-based human computer interaction. ($4.2M)
- Experimentally evaluate language-based methods for image understanding, high assurance, and software environments system composition. ($2.5M)
- Refine and begin experimental evaluation of design technology to include high performance computational prototyping of systems. ($2.9M)
- Experimentally evaluate planning and decision aids prototypes for heterogeneous, distributed software system architectures and tools to support construction and maintenance of advanced intelligent systems. ($2.1M)

(U) FY 1997 Program:

- Develop initial tools and tool kits for development and evaluation of highly interactive, agent and dialogue-based human computer interactions. ($5.9M)
- Advance the capabilities of spoken and written language understanding to solve real-world problems and provide widely usable functionality. ($7.2M)
- Extend and evaluate large-scale statistical modeling, machine learning, and knowledge representation methods for spoken and written language understanding and develop hub formalization that will infuse existing programming languages with new advances in formal methods. ($1.8M)
- Continue the experimental evaluation of design technology for high performance computational prototyping of systems. ($2.8M)
- Experimentally support software evolution by integrating numerous formal and informal information sources in a "hyperweb"; enhance formal notations for software design to include both syntatic and semantic information; and demonstrate multi-language architecture definition and analysis tools. ($5.8M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 1 Basic Research	R-1 ITEM NOMENCLATURE Defense Research Sciences, PE 0601101E, Project CCS-02

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	23.9	24.8	28.4
Appropriated	23.3	22.4	N/A
Current Budget	23.1	22.1	23.5

(U) **Change Summary Explanation**:

FY 1995-97 Reflects minor program repricing and below threshold reprogramming ($.3 million).

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 1 Basic Research	R-1 ITEM NOMENCLATURE Defense Research Sciences, PE 0601101E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Electronic Sciences ES-01	34,401	37,912	39,684	40,078	34,409	34,478	32,533	Continuing	Continuing

(U) **Mission Description**: This project explores and demonstrates electronic and optoelectronic device, circuit, and processing concepts that will provide: (1) new technical options for future electronic and optical systems used in information transmission, gathering and processing; and (2) a substantial increase in performance and cost reduction per function. Research areas include new electronic and optoelectronic device and circuit concepts, Gallium Nitride based laser development, uncooled and novel infrared detector materials, innovative optical arrayed interconnects and smart pixels, optical memory research, artificial neural network (ANN) research, low power electronics, and microelectromechanical systems (MEMS) technology. This basic research project creates the vital new concepts for advanced electronic, optoelectronic, and MEMS components to meet future DoD needs.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Initiated Phase II of the Nanoelectronics program. Thrusts will include combined nanoelectronics and conventional electronics, silicon-based nanoelectronics, chemical self-assembly, and molecular beam epitaxy (MBE) process control and other fabrication techniques. ($12.7M)
  - Demonstrated power reduction by a factor of five through the combination of nanoelectronics and conventional devices.
  - Explored compressed circuitry using multi-valued logic and nanoelectronics.
  - Demonstrated improved process control of MBE, controlling temperature to within 2 degrees and thickness to within 1 nanometer.
  - Determined optimum materials systems for fabricating silicon-based nanoelectronics.
  - Developed chemical self-assembly techniques for electronically active materials.
  - Developed voltage measurement capability suited to nanoelectronics (better than 100 nanometer spatial resolution and 50GHz temporal resolution).
  - Explored compressed circuitry using multi-valued logic and nanoelectronics.
  - Demonstrated utility of nanochannel glasses in fabricating nanoelectronic structures.
  - Utilized nanostructures for high resolution electron and ion-beam technology.
  - Demonstrated three-terminal lateral resonant tunneling transistor.
  - Demonstrated feasibility of magnetic memory with nanometer scale devices.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 1 Basic Research	R-1 ITEM NOMENCLATURE Defense Research Sciences, PE 0601101E, Project ES-01

- Demonstrated optical interconnects for shared memory application. ($2.5M)
- Develop low-power, high-speed analog neural network hardware for accelerating early vision processing algorithms. ($1.5M)
- Demonstrated 2-6 material with <10 power4 defects/cm2 for short wavelength emitters. Demonstrated green cw, room temperature operation of laser operational for 90 minutes. ($1.0M)
- Demonstrated cascading of second order non-linearity's as a means to achieve all-optical switching and the applications of non-linear cross phase modulation as a means to achieve very fast all-optical analog to digital sampling. ($.8M)
- Demonstrated smart pixel arrays integrating transistors with optical emitters capable of simple logic functions and provided foundry service access to custom smart pixel chips. ($2.5M)
- Demonstrated optical interconnect modules for free space optoelectronic processor applications. ($2.3M)
- Establish theoretical foundations for specific neural network architectures, and develop improved architectures for pattern recognition, temporal processing, and adaptive control applications. ($1.2M)
- Demonstrated high-yield, high-uniformity fabrication processes for microelectromechanical system (MEMS) devices and merged MEMS with related fabrication technologies in optics/optoelectronics. Initiated low-bandwidth, large-scale MEMS-based sensor networks. ($6.8M)
- Initiated low-power electronics technology programs in the areas of circuit architecture and power management techniques. ($3.1M)

(U) FY 1996 Program:

- Continue nanoelectronics program with emphasis on combined nanoelectronics and conventional electronics, silicon-based nanoelectronics, chemical self-assembly, and molecular beam epitaxy (MBE) process control and other fabrication techniques. ($12.3M)
  - Develop designs with improved power, performance, and lowered part count compared with circuits using only conventional devices.
  - Explore applications of multi-valued logic to special purpose processing.
  - Demonstrate compressed-area multi-valued logic adder with binary input and output.
  - Demonstrate functional silicon-based nanoelectronic devices.
  - Demonstrate submicron pattern transfer using low-cost elastopolymeric stamps and explore use of self-assembled monolayers for nanoelectronics and for protection of semiconductor wafers during processing.
  - Design prototype hardware and improve user interface software for MBE process control.
  - Develop methods for converting electrical designs to processing protocols.
  - Continue development of lateral patterning techniques.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 1 Basic Research	R-1 ITEM NOMENCLATURE Defense Research Sciences, PE 0601101E, Project ES-01

- Demonstrate materials and device designs to achieve ultra low threshold, high speed direct modulated laser and demonstrate high speed optoelectronic technologies for optical switching applications. ($4.4M)
- Demonstrate photonic device applications of non-semiconductor thin films doped with optically active ions and explore material technologies for monothically integrated optoelectronic components. ($3.6M)
- Demonstrate development of high-density integrated electrical/mechanical systems along with requisite developments of CAD tools, materials data base, test and characterization methods, and manufacturing processes. ($6.2M)
- Initiate development of uv-blue gallium nitride based LEDs and lasers for high density memory, lightwave countermeasures, convert communications, and warfare. ($5.6M)
- Assess thermal response characteristics of thin film material for improved sensitivity uncooled infrared detectors. ($.8M)
- Continue low-power electronics programs in the areas of circuit architecture and power management techniques. Demonstrate CAD tool for static power estimation. ($5.0M)

(U) FY 1997 Program:

- Continue the nanoelectronics program with emphasis on the following thrusts: combined nanoelectronics and conventional electronics, silicon-based nanoelectronics, chemical self-assembly, and molecular beam epitaxy (MBE) process control and other fabrication techniques. ($11.0M)
  - Explore concepts for ultra high density memory, design combined nanoelectronic and conventional circuits for information processing and demonstrate 20X increase in speed-power performance of mux/demux circuits.
  - Optimize silicon-based nanoelectronics fabrication and device design.
  - Demonstrate potential for chemical self-assembled films' use in nanoelectronics.
  - Demonstrate precision process control of semiconductor heterostructures for advanced nanoelectronic devices.
  - Demonstrate improved patterning with critical dimensions below 50 nanometers.
  - Demonstrate silicon-based (silicon-germanium-carbon) resonant tunneling device structures.
- Demonstrate monolithically integrated optoelectronics for information processing and demonstrate feasibility of three-dimensional optically addressed memory. ($3.4M)
- Fabricate small (5 x 5) infrared sensitive arrays as verification of material properties. ($3.0M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 1 Basic Research	R-1 ITEM NOMENCLATURE Defense Research Sciences, PE 0601101E, Project ES-01

- Develop and demonstrate efficient low-voltage conversion/distribution circuits and self-regulating, use-driven power allocation systems. ($6.7M)
- Develop and demonstrate uv pulsed laser diode operation in the gallium nitride system. Identify relationship between defect density and applicability to military applications such as uv solar blind detectors for missile threat warning. ($10.0M)
- Continue low-power electronics programs in the areas of circuit architecture and power management techniques. Demonstrate 256 x 256 pixel image sensor with on-chip 10-bit ADC. Demonstrate adiabatically-switched and power supply. ($5.6M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	35.2	42.6	40.1
Appropriated	34.6	38.3	N/A
Current Budget	34.4	37.9	39.7

(U) **Change Summary Explanation**:

FY 1995-97 Decrease reflect minor repricing adjustments.
FY 1996 Decrease reflects inflation savings used as a funding source of the Bosnia reprogramming action. ($.4M)

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 1 Basic Research	R-1 ITEM NOMENCLATURE Defense Research Sciences, PE 0601101E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Materials Sciences MS-01	27,098	17,585	11,700	11,453	18,691	17,622	19,953	Continuing	Continuing

(U) **Mission Description**: This project is concerned with the development and exploitation of: development of magneto-resistive materials for use in radiation hardened memories and motion medical countermeasure and position sensors; development of forward combat casualty care medical technologies; develop technology for defense against biological weapons; development of high power/high energy density electrochemical power sources (batteries and fuel cells) and research on waste source reduction for DoD-relevant manufacturing processes.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Electrochemistry ($17.1M): Concentrated on use of logistic fuels (e.g. diesel fuel and jet fuel) in advanced energy sources (fuel cells) for military applications.
  - Evaluated novel logistics fuel catalysts, electrolytes, and electrode materials.
  - Developed fuel cell components capable of operating on reformed logistics fuel.
  - Constructed a pilot-scale, supercritical water oxidation reactor (1 gal./min.) and began testing for the destruction of chemical warfare agent simulants, propellants and other DoD hazardous wastes.
  - Expanded support of five hazardous substance research centers to develop technologies for removing DoD hazardous waste and to train DoD and DOE personnel in hazardous waste management.
- Biomedical ($10.0M): Exploited technology base developments in microelectronics, sensors, communications, imaging and simulation to enhance far-forward combat casualty care. This project provides component and modular additions to the Personnel Status Monitor (PSM) under development in PE 0602712E, project MPT-07.
  - Accelerated development of a Ranger Overwatch personnel status monitor (RO-PSM) with standard PSM configuration and added temperature and shiver sensors to detect hypothermia.
  - Developed haptic interface for virtual environments and holographic display for virtual images in simulation.
  - Developed battlefield surgical simulation for injuries to the torso.
  - Continued development of a virtual environment for the individual soldier in order to test and evaluate the efforts of training, equipment, etc. on the health of the soldier.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 1 Basic Research	R-1 ITEM NOMENCLATURE Defense Research Sciences, PE 0601101E, Project MS-01

- Developed and incorporated advanced manipulation and sensory feedback into a telepresence surgery system; explored methods for diminishing latency in tele-manipulation; field testing and evaluation.

(U) FY 1996 Program:

- Electrochemistry. ($10.8M)
  - Develop and demonstrate a high efficiency fuel reformer for fuel cell applications to process logistic fuel.
  - Demonstrate fuel cell operation using either hydrogen or methanol with performance adequate for soldier applications.
  - Test a novel direct oxidation logistics fuel cell concept.
- Biomedical. ($1.7M)
  - Develop miniaturized, conformal design and rechargeable polymer power sources for the Personnel Status Monitor (PSM).
- Biological Warfare (BW) Defense. ($3.2M)
  - Develop technology for antibody deposition on chips for real-time BW sensing.
  - Initiate structure-based design of antibody combining site for spore identification.
  - Develop engineering analysis for miniature environmental air sampler for biological materials into fluids.
  - Demonstrate the feasibility in-vitro of using red blood cells to eliminate pathogens from the blood for the purpose of potential defense against biological weapons.
- Magnetic Materials and Devices. ($1.9M)
  - Enhance magneto-resistance ratio at low magnetic fields for faster response and higher sensitivity of magnetic devices.
  - Evaluate spin transistor and spin tunneling device for use in sensors and non-volatile memories.

(U) FY 1997 Program:

- Electrochemistry. ($8.6M)
  - Develop and test a thermally integrated fuel cell stack and reformer which operates on logistics fuel.
  - Demonstrate direct, liquid-feed methanol fuel cell stack operation with performance adequate for soldier applications.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 1 Basic Research	R-1 ITEM NOMENCLATURE Defense Research Sciences, PE 0601101E, Project MS-01

- Biomedical. ($1.6M)
  - Develop knowledge-based control algorithms for the Personnel Status Monitor.
  - Develop "smart" catheters for battlefield blood chemistry assessments.
- Magnetic Materials and Devices. ($1.5M)
  - Fully characterize spin transistor and other spin polarized transport devices for use in ultra-high density memory applications.

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	28.5	22.4	23.9
Appropriated	27.8	18.2	N/A
Current Budget	27.1	17.6	11.7

(U) **Change Summary Explanation**:

FY 1995 Decrease reflects minor repricing adjustments.
FY 1996 Decrease reflects inflation related reductions. ($.6 million)
FY 1997 Decrease reflects termination of bioremediation program, and transfer of chemical Biological Programs for consolidated management.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E

COST (In Thousands)	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Computing Systems and Communications Technology	**376,736**	**363,038**	**346,957**	**365,826**	**386,360**	**410,240**	**430,546**	**Continuing**	**Continuing**
JASON ST-01	1,227	1,163	1,196	1,190	1,200	1,200	1,200	Continuing	Continuing
Intelligent Systems & Software ST-11	73,569	93,087	98,441	107,498	112,807	110,256	117,007	Continuing	Continuing
High Performance Computing ST-19	234,114	186,562	191,150	192,029	208,157	237,981	250,911	Continuing	Continuing
Software Engineering Technology ST-22	38,424	25,815	18,072	19,609	20,196	20,803	21,428	Continuing	Continuing
Monitoring Technologies ST-23	19,525	28,267	0	0	0	0	0	0	N/A
Information Survivability ST-24	9,877	28,144	38,098	45,500	44,000	40,000	40,000	0	N/A

(U) **Mission Description**: This program element is budgeted in the Applied Research Budget Activity because it funds projects directed toward the application of advanced, innovative computing systems and communications technologies. These programs include:

(U) DARPA leadership of the Federal High Performance Computing and Communications Initiative to develop technologies that lead to successive generations of more secure, higher performance, and more cost-effective scalable systems critical to defense operations and federal needs.

(U) The efforts funded in the Intelligent Systems and Software project focus on the development of new information processing technology concepts that lead to fundamentally new software and intelligent system capabilities. Emphases

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E

are in intelligent systems including autonomous systems, interactive problem solving, intelligent integration of information, software development, and manufacturing automation and design engineering.

(U) The Software Engineering Technology project supports the Software Engineering Institute (SEI) and Software Technology for Adaptable, Reliable Systems (STARS) through FY 1995. SEI works to transition state-of-the-art technology, and introduce and promulgate modern software in the defense industry.

(U) The Monitoring Technologies project provides the technology to collect and fuse surveillance sensor data, with particular focus on those technologies needed by the U.S. to support the Comprehensive Nuclear Test Ban Treaty (CTBT) negotiations which began in 1994, the Non-Proliferation Treaty conference which convened in 1995, and the regimes established to verify these treaties CTBT verification Readiness transfers to Air Force P.E. 0305154F in FY 1997.

(U) The Information Survivability project develops the technology base underlying the solutions to protecting DoD's mission-critical information systems against attack upon or through the supporting infrastructure. These technologies lead to generations of stronger protection, higher performance, and more cost-effective security solutions scalable to several thousand sites and to high-performance computing technologies.

(U) The JASON Group supports studies for the national security community.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: March 1996
APPROPRIATION/BUDGET ACTIVITY: RDT&E, Defensewide; BA 2 Applied Research	R-1 ITEM NOMENCLATURE: Computing Systems and Communications Technology, PE 0602301E

COST (In Thousands)	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
JASON ST-01	1,227	1,163	1,196	1,190	1,200	1,200	1,200	Continuing	Continuing

(U) **Mission Description:** This project supports the JASONs, an independent group of distinguished scientists and technical researchers that provides analysis of critical National Security issues. JASON membership is carefully balanced to provide a wide spectrum of scientific expertise and technical analysis in theoretical and experimental physics, materials, information sciences, and other allied disciplines. The JASON process ensures senior government leaders have available the full range of U.S. academic expertise on issues critical to National Security involving all classified and unclassified information.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Continued investigations involving: structural acoustics; advanced land combat vehicles; precision strike; ASW; nuclear weapon proliferation; counterproliferation; joint U.S.-Russian space exploration and global surveillance and communications.

(U) FY 1996 Program:

- Continue studies in: nuclear and chemical weapons proliferation, precision strike weapons, global surveillance and communications; counter drug surveillance techniques; shallow water ASW; and advanced signal processing.

(U) FY 1997 Program:

- Continue studies in: counterproliferation of nuclear, chemical and biological weapons, precision deep strike weapons, battlefield information systems, battlefield planning and control, counter drug and law enforcement surveillance techniques; advanced sensor technologies; and global surveillance and intelligence.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-01

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	1.2	1.2	1.2
Appropriated	1.2	1.2	N/A
Current Budget	1.2	1.2	1.2

(U) **Change Summary Explanation**: No change.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Intelligent Systems and Software ST-11	73,569	93,087	98,441	107,498	112,807	110,256	117,007	Continuing	Continuing

(U) **Mission Description:** This project develops new information processing technology concepts that lead to fundamentally new software and intelligent systems capabilities. This will enable advanced information systems to more effectively accomplish decision-making tasks in stressful, time sensitive situations and create efficient software systems supporting computer and software intensive defense systems. Major areas of technical emphasis are: (a) intelligent systems (artificial intelligence) including autonomous systems, image understanding, interactive problem solving and intelligent integration of information from heterogeneous sources; (b) software development technology including languages, algorithms, data and object bases, domain specific software architectures, software prototype technology, software design tools, software reuse, and advanced software engineering environments; (c) manufacturing automation and design engineering, including the development of advanced software systems which support sharing of engineering knowledge, advanced product and process design representations, integrated product and process design, software tools for design process management, manufacturing process planning, manufacturing process control and demonstrations; (d) Text Video Speech (TVS) program focuses on the integration and application of emerging language understanding technology for both C4I and Intelligence community needs; and (e) organizing resources to obtain access to multiple systems and decision aids that provide logistical information when and where it is needed.

(U) **Program Accomplishments and Plans:**

(U) FY 1995 Accomplishments:

- Experimentally evaluated the integration of multiple intelligent systems and software technologies in multiple autonomous vehicles. ($4.2M)
- Initiated transition in focus from image understanding to image exploitation for vision guided navigation, photo-intelligence, and target detection. Continue multidisciplinary vision research with Office of Naval Research. ($10.4M)
- Developed initial prototype implementations for human-aided machine translation, document understanding, and robust speech understanding in adverse acoustic conditions. ($12.3M)
- Developed initial prototype implementations of real-time planning and control algorithms. ($3.9M)
- Enhanced knowledge-based planning and decision aids to support the rapid construction of multiple crisis action plans. ($6.9M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-11

- Developed initial prototype implementations of advanced intelligent integration methods for information fusion, aggregation, summarization and explanation. ($4.8M)
- Experimentally evaluated language-based methods for describing domain specific software architecture and tools that facilitate composing a software system based on a domain specific architecture. ($4.3M)
- Experimentally evaluated advanced software environment that supports composition tools for composing software, integration, and software development and testing using animation techniques. ($3.7M)
- Developed prototypes to support highly distributed, wide bandwidth information processing applications that require persistent objects. ($4.8M)
- Enhanced intelligent product and process representations and apply to a scalable framework for large complex systems. ($1.0M)
- Developed information infrastructure services for manufacturing, including network access to engineering analysis and rapid prototyping services and experimentally evaluate agent-based architectures for sharing design knowledge, manufacturing process planning, and manufacturing control. ($8.8M)
- Initiated development of a modular testbed for human computer interaction technology insertion for testing, evaluating and demonstrating. ($4.3M)
- Supported software initiatives at the Software Institute Johnstown. ($4.2M)

(U) FY 1996 Program:

- Enhance advanced image understanding methods for vision guided navigation, cartographic modelling, and target detection and identification, and facilitate transition and adoption of the resulting technology. ($10.4M)
- Experimentally evaluate implementations for human-aided machine translation, document understanding, and robust speech understanding in adverse acoustic conditions. ($8.7M)
- Experimentally evaluate implementations of real-time planning and control algorithms. ($2.5M)
- Evaluate knowledge-based planning and decision aids to support the rapid construction of multiple crisis action plans in an operational exercise. ($9.4M)
- Integrate knowledge based planning, decision, and scheduling aids to support the rapid construction of multiple crisis action plans. Collaborate with Rome Labs knowledge-based planning efforts. ($1.9M)
- Developed new techniques for intelligently locating, filtering, accessing, and integrating information from disparate, heterogenous, distributed information sources and demonstrate the use of those techniques in accessing information for air campaign planners, logistics planners, satellite imagery users, weapon system engineers, and others. ($9.5M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-11

- Developed new persistent object management technology to enable the distributed, parallel, object oriented databases to handle massive amounts of geospatial and other information. ($3.3M)
- Developed an initial library of knowledge base components to support the creation and maintenance of High Performance Knowledge Bases in military command and control. ($1.8M)
- Develop planning and control algorithims for tasking multiple homogeneous assets in support of small unit operations. ($3.5M)
- Integrate Artificial Intelligence based research technologies with numerical simulations and CAD Models, and demonstrate a three fold reduction in trade-off analysis and design optimization. ($11.4M)
- Continue the human computer interaction heterogenous testbed product development and insertion. Test, evaluate and demonstrate enhancements to the user community. ($6.9M)
- Define consensus Architecture Description Language and Interactive Architecture Synthesis Tools and initiate development of tools and initiate development of tools for complex system. ($6.9M)
- Develop and demonstrate multi-echelon, collaborative logistical support tools that integrate planning, execution, monitoring and decisions support systems to achieve real time logistical reallocation and redeployments within and between commands. ($4.3M)
- Support software initiatives at the National Applied Software Engineering Center (NASEC), Johnstown. ($9.6M)
- Support Software Productivity Consortium. ($3.0M)

(U) FY 1997 Program:

- Continue development of human-computer interaction, heterogeneous testbed products and insertion. Test, evaluate and demonstrate enhancements to the developer and user communities. ($6.4M)
- Experimentally evaluate methods for building information detection filters from text, and baseline topic concept recognition from radio news broadcasts. ($4.9M)
- Evaluate distributed design tools and demonstrate multi-agent systems for capture of design history. ($14.7M)
- Develop modular Human Language Technologies to support easy, low-cost, rapid technology transfer and application development for Document Understanding, Machine Translation, and Speech Understanding. ($8.9M)
- Develop knowledge-acquisition tools for planning and decision aids systems. ($10.7M)
- Extend Architecture Description Language for complex systems to include performance and context information. ($12.8M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-11

- Complete the experimental evaluated prototype implementations to support highly distributed, wide bandwidth information processing applications that require persistent objects. ($1.3M)
- Support software initiatives at the NASEC, Johnstown. ($10.0M)
- Image understanding applications effort that will transition results in automatic target recognition, terrain modeling for simulation, video surveillance, image database retrieval, and integrated reconnaissance and operations planning to other DoD agencies; continue multidisciplinary vision research with Office of Naval Research. ($6.4M)
- Develop in the Intelligent Integration of Information area, tools and techniques to enable the rapid construction of information filtering, accessing, and integration software to enable the dynamic management of massive amounts of battlefield information. ($12.3M)
- Develop a library of knowledge base components, composition tools, and an initial integrated development environment to support the creation and maintenance of High Performance Knowledge Bases in battlefield awareness and military command and control. ($10.0M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	75.9	95.0	100.2
Appropriated	77.9	95.8	N/A
Current Budget	73.6	93.1	98.4

(U) **Change Summary Explanation**:

FY 1995 Decreased to finance TRP earmarks.
FY 1996 Decrease reflects rescission of Natural Language Text Program ($-5.0 million), below threshold reprogramming for the High Performance Knowledge Base Program ($+1.9 million), and minor repricing ($+.4 million).
FY 1997 Decrease reflects minor repricing.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E

COST (In Thousands)	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
High Performance Computing ST-19	234,114	186,562	191,150	192,029	208,157	237,981	250,911	Continuing	Continuing

(U) **Mission Description:** This project develops the computing, networking, and associated software technology base underlying the solutions to computational and information-intensive applications for future defense and federal needs. These technologies lead to successive generations of more secure, higher performance, and more cost-effective scalable systems associated software technologies, advanced mobile information technology and prototype experimental applications critical to defense operations as well as the federal government. Each component of this program will integrate capabilities developed under the Information Survivability initiative (Project ST-24) to satisfy defense requirements for secure systems.

(U) The Defense Information Enterprise component develops underlying networking systems technology that enables applications developers to demonstrate prototype solutions to national and global-scale defense problems. These include network-based information services, application demonstrations, mobile information systems, and experimental capabilities supporting computing systems developmental efforts. The component is strongly supported across other DoD and federal agencies. This program has been reduced in 1996 and beyond to activities associated with defense based global mobile information systems.

(U) The Systems Environments component develops scalable software which is tailored toward easing the use of systems by applications programmers. This includes languages, runtime services, scalable software library technologies, and experimental applications.

(U) The Networking component develops high performance networking technologies and associated capabilities. Research is coordinated with network technology and service deployments made by DoD, NASA, and other federal agencies.

(U) The Scalable Systems and Software component develops software and hardware technologies leading to a secure scalable computing and communications technology base for systems configured over a wide performance range, from mobile handheld devices to desktop workstations to the largest-scale, highest performance systems.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-19

(U) The Microsystems component develops design tools, environments, and design infrastructure to support the research and development of advanced scalable parallel computing components and embedded computing systems. Microsystems leverages the scalable computing technology base to accelerate and support the design of complex electronic systems. Microsystems also supports innovative system prototyping techniques in hardware and software as well as early small-scale architecture experiments leveraging scalable computing technology, micro-architectures, low-energy components and processes, optimization techniques, and advanced packaging technology.

(U) Defense Technology Integration and Infrastructure combines state-of-the-art computing and information technologies focused on critical defense applications. These include developing embeddable systems based upon scalable technologies, and projects which accelerate technology transition of advanced research to intelligence, command and control, and other major DARPA and DoD programs.

(U) **Program Accomplishments and Plans:**

(U) FY 1995 Accomplishments:

- Defense Information Enterprise. ($29.0M)
  - Developed initial prototype of common authentication, authorization, and accounting services infrastructure based on security mechanisms in Information Survivability (Project ST-24) program.
  - Demonstrated prototypes of distributed digital library technology including techniques for scalable storage management and data repositories, persistent object bases, and multimedia objects.
  - Demonstrated copyright management system, providing proof of concept including fully electronic copyright registration, recordation, rights transfer, and management.
  - Demonstrated mobile computing system Computer Aided Design (CAD) environment through the design of early prototype, high bandwidth, pico-cellular, and wireless access points to the wireline infrastructure.
  - Demonstrated network-based access to Multichip Module fabrication services.
- Systems Environments. ($29.5M)
  - Demonstrated prototype integrated HPC programming environment for Fortran and C++ on which applications run transparently on several distinct scalable computer architectures without change.
  - Completed detailed study of I/O characteristics of scalable computers under real application load, identifying significant bottlenecks.
  - Demonstrated tools for performance tuning of application software using dynamically-collected statistics.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-19

- Demonstrated portable scalable software libraries across three major computer architectures applied to semiconductors device simulation.

• Networking. ($29.0M)
  - Demonstrated bandwidth, delay, and service reservation guarantees for networks in support of real-time control and critical services.
  - Demonstrated Synchronous Optical Network (SONET) and Asynchronous Transfer Mode (ATM) encryption technologies at 155 Mbps (OC-3c).
  - Deployed small-scale, initial prototype of gigabit-per-second-class, nation-spanning infrastructure in support of high performance computing applications.
  - Demonstrated advanced network capabilities, including multicast-based services and next generation Internet protocols with improved ease of use.
• Scalable Systems and Software. ($52.7M)
  - Designed system architectures incorporating components such as programmable protocol engines to support scalability and high performance.
  - Demonstrated systems tools for on-line analysis of a real-time operating systems for scalable, distributed HPC systems.
  - Demonstrated operating system ability to confine processes to isolated domains.
  - Demonstrated first HPC single node operating at 1 Gflop.
• Microsystems. ($35.6M)
  - Demonstrated derivation of electrical parameters from 3-D process models using early computational prototyping methods.
  - Demonstrated prototype secure distributed design environment for electronic systems.
  - Initial demonstration of microarchitectures for advanced packaging and scalable units of replication.
  - Demonstrated scalable, high performance, low-latency switch technology for workstation clusters.
• Defense Technology Integration and Infrastructure. ($34.4M)
  - Demonstrated use of advanced visualization environment in a defense application.
  - Developed a set of communication benchmarks, communication protocols, and prototype for embedded, scalable military systems.
  - First Message-Passing Interface (MPI) demonstration of cross-architecture application portability.
  - Demonstrated integrated access to several different special, classified defense and intelligence information systems.
  - Demonstrated 10 gigaflops/cu.ft. militarized HPC System.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-19

- Additional FY 1995 Activities. ($23.9M)
  - The Maui HPC Center Program increased the computing power available to defense scientists/engineers by providing the key commercial application software necessary to exploit scalable computing systems.
  - The Intelligent MetaComputing Center utilized existing defense experimental testbeds and defense-related applications to demonstrate the integration of scalable computing and high performance networks.
  - The Rome Lab Demonstration integrated existing decision support technology in a distributed networking environment to demonstrate the feasibility of effective mission planning across multiple networks.
  - The Lifecycle Improvements by Networking Critical Manufacturing Technologies Program utilized commercially-available software and advanced information technology to develop intelligent agents to search multiple databases with minimal user input and guidance.

(U) FY 1996 Program:

- Global Mobile Information Systems. ($16.3M)
  - Initial prototype of adaptive extensions to Internet services in support of mobility.
  - Initial prototypes of untethered node hardware/software architectures for mobile computing.
  - Demonstrate design environments supporting simulation and synthesis of wireless systems spanning integrated circuits to network applications.
  - Complete the experimental evaluation of the integration of multiple advanced intelligent systems and software technologies in autonomous applications.
- Systems Environments. ($22.0M)
  - Evaluate first generation of fully scalable OS software and programming environments on small-scale versions of teraops computing systems.
  - Define second generation of High Performance Fortran with extensions for task parallelism and support for scalable I/O.
  - Demonstrate extensions of portable scalable libraries to incorporate object-oriented technology and a broader set of applications.
  - Enhance and experimentally evaluate advanced software environment that supports composition tools for software creation, integration, development, and testing using animation techniques.
- Networking. ($26.8M)
  - Prototype networks at greater than 40-gigabit-per-second speed using optical technologies and experimentally validate scalable network protocols at the higher speeds.
  - Prototype secure nomadic computing architecture integrated into existing wide area networks.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-19

  - Deploy reference implementation of protocol-independent, multicast-capable infrastructure as basis for development of advanced services.
  - Demonstrate robust and secure network-level infrastructure protocols to include directory services and resource allocation.
  - Demonstrate technology for autonomous, node-level network management.
- Scalable Systems and Software. ($37.6M)
  - Demonstrate user-extensible microkernel operating system technology, integrating compiler and run-time support services.
  - Demonstrate computing node architectures that dramatically increase internal memory and communications bandwidths.
  - Demonstrate I/O enhancements to a scalable operating system that overcomes identified bottlenecks leading to significant improvements in throughput.
- Microsystems. ($34.7M)
  - Perform early demonstration of parallel, fully-hierarchical Automatic Test Generation for both combinational and sequential circuits.
  - Demonstrate fault-tolerant and reliability design tools supporting large-scale HPC systems developments.
  - Demonstrate message-passing/shared-memory hybrid architecture protocol accelerator component.
  - Demonstrate distributed computing architectures based on low-cost, low-latency switching technology.
  - Prototype emulation-enhanced system simulation capabilities for microsystems design.
  - Demonstrate integrated module-level synthesis capability.
- Defense Technology Integration and Infrastructure. ($41.4M)
  - Develop and provide experimental testbed services employing advanced high performance computing technologies for defense users.
  - Prototype embedded computing system modules with scalability concepts containing memory hierarchy and power on a single unit of replication.
  - Perform integration tests in key defense applications such as advanced distributed simulation, advanced distributed collaboration, advanced communications and control, and advanced human computer interfaces.
  - Demonstrate first fine-grained high performance embedded and scalable computer system.
  - Demonstrate graphical program environments for embedded systems.
  - Demonstrate prototype toolkits supporting development of applications adaptive to changes in the computing and communication environment.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-19

- Demonstrate prototype of information services through a testbed incorporating information management and secure transactions.

• Metacomputers ($7.8M)
- Establish a metacomputing center testbed in close proximity to DARPA headquarters. ($7.8M)

(U) FY 1997 Program:

• Global Mobile Information Systems. ($17.6M)
- Demonstrate bandwidth-adaptive multimedia node for mobile computing.
- Demonstrate advanced mobile networking algorithms and protocols.

• Systems Environments. ($17.7M)
- Demonstrate optimizing compilers with 5-to-10 times runtime performance improvement through partial compilation and late optimization during program execution.
- Demonstrate High Performance C++ with extensions for both Data Parallel and Task Parallel exploitation of concurrency.
- Prototype common runtime services reducing burden on individual compiler R&D efforts.
- Provide scalable versions of widely-used commercial engineering software, including MCS NASTRAN, leveraging scalable software library technology available to the defense community.
- Demonstrate feasibility of utilizing advanced software environment that supports composition tools for composing software, integration, and software development and testing using animation techniques in military environment.

• Networking. ($33.7M)
- Demonstrate higher level communication services that coordinate distributed computing resources across the network environment.
- Demonstrate transport protocols for multigigabit networks.
- Demonstrate systems for coordinating sets of workstations as a single computing system.
- Deploy reference implementation of a common base set of network infrastructure protocols and services necessary for secure and reliable network operation.
- Demonstrate wide-area 40-gigabit-per-second and lab-prototype 100+ gigabit-per-second electro-optical transmission and switching systems.
- Develop advanced multicast-based services to include refinements of collaboration systems and autonomous network processes.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-19

- Scalable Systems and Software. ($32.8M)
  - Demonstrate extensible modular operating system framework supporting real-time, distributed, and limited fault-tolerant scalable computing applications.
  - Demonstrate high-availability systems scalable in performance to 1 teraflop.
  - Demonstrate distributed cluster technology scalable to teraflops.
  - Demonstrate advanced object management systems integrated with operating systems and applications to achieve efficient use of memory while enhancing execution speed.
  - Demonstrate the prototype of a scalable operating system that incorporates high assurance capabilities for the Information Survivability program.
- Microsystems. ($32.5M)
  - Demonstrate high-level, portable parallel test generation system.
  - Develop fully-integrated, parameterized, constraint-driven design libraries.
  - Demonstrate initial multisite collaborative design research environment for integrated circuit process simulation and remote experimentation over the NII.
  - Demonstrate distributed shared memory components on cluster of workstations.
- Defense Technology Integration and Infrastructure. ($56.9M)
  - Complete the development of experimental testbed services employing high performance computing technologies to special defense users.
  - Demonstrate integrating testbed architecture incorporating advanced distributed simulation, advanced distributed collaboration, advanced communications and control, and advanced human computer interfaces.
  - Demonstrate initial capabilities of intelligent information services architecture with multiple mechanisms for describing resource capabilities and with a uniform interface to hybrid search methods for resource retrieval.
  - Demonstrate enhanced feature, real-time distributed operating systems for embeddable HPC.
  - Demonstrate 100 gigaops/cu. ft. militarized HPC.
  - Develop real-time image understanding algorithms for use in image registration, target recognition, and autonomous navigation for ground level and overhead reconnaissance and surveillance.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-19

(U) **Program Change Summary:** *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	241.2	234.6	224.2
Appropriated	230.8	194.4	N/A
Current Budget	234.1	186.6	191.2

(U) **Change Summary Explanation**:

FY 1995 Increase due to funding TRP earmark for Lifecycle Networking Improvement.
FY 1996 Decrease reflects Bosnia reprogramming action ($3.3 million) and below threshold reprogramming actions ($4.5 million).
FY 1997 Decrease reflects program repricing.

(U) **Other Program Funding Summary Cost:** N/A

(U) **Schedule Profile**: N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Software Engineering Technology ST-22	38,424	25,815	18,072	19,609	20,196	20,803	21,428	Continuing	Continuing

(U) **Mission Description:** Software is key to meeting DoD's increasing demand for quality, affordability, and timeliness of national defense systems. There is a critical need to rapidly transition state-of-art technology and best practices to improve the acquisition, engineering, fielding, and evolution of software-intensive DoD systems. This project funds the technology transition activities of the Software Engineering Institute (SEI) at Carnegie Mellon University. Through FY95 funding for the Software Technology for Adaptable, Reliable Systems (STARS) program was included. In FY96, funding for the Software Managers Network and ASSET are included at Congressional direction.

(U) The SEI is a Federally Funded Research and Development Center (FFRDC), established in 1984, as a part of the DoD's software initiative which, in addition, included STARS and the Ada Program. The SEI identifies high leverage technologies and practices, and establishes transition mechanisms to enable their exploitation by both "in-house" government facilities and the industrial base where the bulk of defense software is produced. The Institute works across government, industry, and academe to identify those state of the art technologies and best practices that are best suited for rapid adoption in defense systems and to determine effective means for transitioning these technologies and practices.

(U) The SEI strategy is to bring engineering discipline to software development and maintenance. The SEI focuses on software technology areas judged to be of the highest payoff in meeting defense needs. It creates projects in these selected areas to identify, evaluate, mature and transition critical technologies. Current focus areas include Software Process, Software Risk Management, Disciplined Engineering of Software-Intensive Systems, and Trustworthy Networks.

(U) **Program Accomplishments and Plans:**

(U) FY 1995 Accomplishments:

- Support to Services in STARS demonstration projects. ($6.0M)
- Test and evaluation of software architectures and implementations developed using STARS technologies on demo projects. ($5.7M)
- Revised STARS concepts, processes, methods, tools based on demonstration projects results. ($4.0M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-22

- Refined STARS technology transition strategies, continued support for the Technology Transition affiliates program, and continued commercialization initiatives. ($4.0M)
- Enhanced STARS ASSET operation and capabilities. ($1.7M)
- Developed and field tested techniques and tools for process maturity modeling, software process improvement, and software engineering measurement. ($4.5M)
- Developed and field tested techniques and tools for software risk management. ($2.4M)
- Initiated series technology projects focused on product line engineering, architecture-centered systems,and predictive engineering. ($7.0M)
- Developed techniques for software security incident handling, security improvements for tools, and trustworthy system technology maturation. ($.5M)
- Continued related activities for integrated transition strategies and methods, creation of software engineering professional infrastructure, and broad dissemination of knowledge to the government, industrial and academic communities. ($2.6M)

(U) FY 1996 Program:

- Extend, integrate, and evaluate software process technology including: demonstrating and evaluating support for software process definition involving integrated product teams; completing Version 2 of the Capability Maturity Model (CMM) with added guidance for higher maturity levels and harmonization with ISO 9001; developing initial CMM statistical validation. ($3.8M)
- Develop and transition risk assessment methods and tools including: Software Acquisition Capability Maturity Model (SA CMM); metrics and quantitative methods for evaluating and controlling software risks; risk management approaches for open systems. ($2.3M)
- Develop and evaluate mechanisms to support technology choices by system developers including: formalized methods for domain analysis and engineering; software understanding technology/capabilities; software engineering environments; Open Systems; best practices in evaluating software architectures. ($7.0M)
- Evaluate and transition technology and best practices related to developing trustworthy systems, including: establishing a database for vulnerability and incident analysis; developing guidelines for product security and developing improved security risk evaluation methods. ($1.1M)
- Continue activities supporting the creation of a software engineering professional structure and broad dissemination of knowledge to the government, industrial and academic communities. ($3.0M)
- Software managers network will support the development and application of active learning tools for senior level management. ($4.9M)
- Continue the enhancement of STARS ASSET operations and capabilities. ($3.7M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-22

(U) FY 1997 Program:

- Integrate and enhance software process models, improvement methods, and analytical capabilities, including: developing a framework for integration of maturity models; developing and validating a method for analysis of return on investments in process improvements; establishing a repository of process-related experience. ($3.6M)
- Establish repository services for a risk management experience base; investigate groupware techniques for efficient development and capture of risk related information. ($2.6M)
- Expand and improve architecture-centered technologies for product lines and evolutionary systems, including: developing and transitioning domain engineering technologies; defining disciplined approaches to managing and evolving legacy systems; developing criteria for assessing open systems. ($6.7M)
- Study effective countermeasures for information warfare against defense software intensive systems, including: developing software security risk taxonomy and guidelines; developing security analysis toolkit; creating guidelines for the acquisition of trustworthy open systems. ($2.5M)
- Investigate team approaches to software engineering, including the evaluation of COTS products to support collaborative work, developing a human interactive capability framework and dissemination of knowledge to the government, industrial and academic communities. ($2.7M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	40.2	19.2	19.1
Appropriated	39.5	35.6	N/A
Current Budget	38.4	25.8	18.1

(U) **Change Summary Explanation**:

FY 1995 Decrease reflects minor repricing.
FY 1996 Decrease reflects DD-1415 reprogramming of Global Broadcast System ($8.0 million), rescission of Software Managers Network ($1.0 million) and below threshold reprogramming ($.8 million).
FY 1997 Decrease reflects minor repricing.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-22

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E

COST *(In Millions)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Information Survivability ST-24	9,877	28,144	38,098	45,500	44,000	40,000	40,000	0	N/A

(U) **Mission Description:** This project develops the technology base underlying the solutions to protect DoD's mission-critical information systems against attack upon or through the supporting infrastructure. These technologies lead to generations of stronger protection, higher performance, and more cost-effective security solutions scalable to several thousand sites and to high performance computing technologies. Technologies developed under this project will be exploited in High Performance Computing (ST-19) and other defense programs to satisfy defense requirements for secure and survivable systems. This program is an expansion of investments in information security made previously in High Performance Computing.

(U) Information Survivability focuses on early prototypes of software and hardware technologies leading to scalable protection for large-scale, heterogeneous systems usable over a wide range of performance in diverse threat environments. High confidence networking technologies will be developed consisting of security mechanisms and value-added security services for integration into network technologies. High confidence computing systems will be developed that provide modular security services and mechanisms, provide high reliability for distributed computations, and allow geographically-separated parts of an organization to interact as if they shared a common security perimeter. This also includes secure and fault-tolerant operating systems, firewalls, and system management tools. Assurance and integration tools will aid the development of high assurance and trusted systems that add expression of modular system structures, networking, and other distributed-system protocols and the ability to reason about their security properties.

(U) Survivability technologies will be developed to mitigate national and defense computing infrastructure vulnerabilities that could be exploited by an information warfare enemy. Intrusion-detection systems will allow attacks on the defense infrastructure to be detected, the damage to be assessed, and appropriate response to be taken. Technologies will be developed to allow crisis-mode operation of critical infrastructure components. Robust networking protocols will be designed to facilitate continuous operations in hostile environments.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-24

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- High Confidence Networking. ($7.0M)
  - Developed basic authentication and authorization mechanisms based on digital signatures, cryptography, and privacy-enhanced mail for use in a common infrastructure.
  - Began operation of certification authority supporting privacy-enhanced mail and other secure services.
  - Completed prototype implementation of digital signature hierarchy toolkit and domain-name system enhancements.
  - Demonstrated prototype signature/timestamp server with associated access tools for location-independent object security.
  - Completed proof-of-concept Asynchronous Transfer Mode (ATM) encryption units for use in experimental ATM networks.
- High Confidence Computing Systems. ($2.9M)
  - Demonstrated operating system capability for strict process separation.

(U) FY 1996 Program:

- High Confidence Networking. ($8.1M)
  - Demonstrate prototype of secured routing protocols.
  - Partial development of a crytographic applications programming interface (CAPI) for algorithm independence and ease of integration of security into applications.
- High Confidence Computing Systems. ($10.2M)
  - Demonstrate cryptographic-applications programming interface to allow secure applications to be built independent of the cryptography used.
  - Demonstrate high-assurance microkernel for use in secure operating systems.
- Assurance and Integration. ($3.8M)
  - Begin work on dynamic security metrics and evaluation tool for white-box evaluation of security of systems with respect to a threat model.
- Survivability of Large Scale Systems. ($6.0M)
  - Begin work on verified robust secure multicast protocols able to tolerate Trojan horses and malicious code.
  - Complete initial intrusion-detection prototype.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-24

(U) FY 1997 Program:

- High Confidence Networking. ($10.1M)
  - Demonstrate crytographic applications programming interface (CAPI)-conformant security services to support electronics commerce and other applications.
  - Integrate basic security services into critical networking protocols for enhanced infrastructure protection.
- High Confidence Computing Systems. ($12.1M)
  - Develop services for defining and enforcing configurable security policies in secure operating systems.
  - Demonstrate increased penetration resistance of firewalls and secure dynamic enclaves by using domain isolation and policy-aware authentication.
- Assurance and Integration. ($7.1M)
  - Demonstrate a tool for secure refinement of secure software architectures.
- Survivability and Vulnerabilities. ($8.8M)
  - Develop limited traceback capability for intrusion-detection systems.
  - Demonstrate verified high-availability networking protocols that can tolerate network partitions.

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	10.0	35.0	25.0
Appropriated	9.7	27.8	N/A
Current Budget	9.9	28.1	38.1

(U) **Change Summary Explanation**:

FY 1995-96 Changes reflect minor program repricing and below threshold reprogramming ($.5 million) for high assurance computing.

FY 1997 Increase reflects OSD-directed expansion of Information Survivability efforts.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology, PE 0602702E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Tactical Technology	**119,174**	**127,205**	**117,944**	**133,075**	**146,083**	**145,119**	**166,397**	**Continuing**	**Continuing**
Naval Warfare Technology TT-03	48,514	39,512	32,639	24,837	33,000	36,553	34,172	Continuing	Continuing
Advanced Land Systems Technology TT-04	28,335	35,670	22,125	19,000	30,000	33,909	51,686	Continuing	Continuing
Advanced Targeting Technology TT-05	5,916	7,000	0	0	0	0	0	0	N/A
Advanced Tactical Technology TT-06	36,409	38,624	45,995	50,553	56,418	57,024	62,728	Continuing	Continuing
Aeronautics Technology TT-07	0	0	0	10,000	10,000	10,000	17,811	Continuing	Continuing
Advanced Logistics TT-10	0	6,399	17,185	28,685	16,665	7,633	0	0	N/A

(U) **Mission Description**: This program element is budgeted in the Applied Research Budget Activity because it supports the advancement of concepts and technologies to enhance the next generation of tactical systems. The Tactical Technology program element funds a number of projects in the areas of Naval Warfare, Advanced Land Systems, Advanced Tactical, and Advanced Logistics technologies.

(U) The Naval Warfare Technology project is focusing on three primary areas of research: Simulation Based Design (SBD); Command, Control, Communications and Intelligence/Synthetic Environments (C3I/SE) and Ship Systems Automation (SSA). The Simulation Based Design program will provide the tools required to integrate cost, performance and manufacturing considerations throughout the design process. The SBD program is developing and demonstrating a prototype infrastructure that will enable a significant positive change in the acquisition process for large, complex warfighting systems utilizing virtual prototypes in synthetic environments. In the C3I/SE program, advanced

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology, PE 0602702E

information technologies are being integrated into advanced prototype systems to provide improved battlefield awareness and dominance to mobile command centers in the field. The Ship Systems Automation program is developing a highly integrated sensor, weapons control, and battle damage suite to reduce costly shipboard manning requirements.

(U) The Advanced Land Systems Technology project supports three efforts: Small Low-cost Interceptor Device (SLID); Operations-Other-Than-War (OOTW); and the final year of the Foreign Cooperative Demonstrations program. The SLID program will develop and test a system for providing protection against missiles and projectiles with explosive warheads. The OOTW program is developing tools such as enhanced sensors, communications upgrades, and new techniques to detect and neutralize mines and other ordnance for use by the Military Departments in domestic situations, peacekeeping operations, and low intensity conflicts. The Foreign Cooperative Demonstration program is applying technology developed by foreign sources to improve the survivability of armored vehicles.

(U) The Advanced Tactical Technology project is exploring the application of compact lasers, microwave radiation and advanced mathematical algorithms to enhance the performance of radars, sensors, communications, and electronic warfare and target recognition systems. The technologies under development will improve infrared countermeasures, enable active infrared suppression, permit faster signal processing, improve target recognition, and create smaller, more capable microwave devices.

(U) Finally, the Advanced Logistics project (formerly TRANSTECH) will develop and demonstrate technologies that will make a fundamental difference in transportation and logistics planning and operations in the 21st Century. Developmental efforts will focus on establishing a board network and computer environment (TRANSWEB); transportation models and simulations; and revolutionary changes to physical systems that impact intermodal system performance and efficiency.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology, PE 0602702E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Naval Warfare Technology TT-03	48,514	39,512	32,639	24,837	33,000	36,553	34,172	Continuing	Continuing

(U) **Mission Description:** The Naval Warfare Technology project develops advanced technologies for application to a broad range of naval requirements. The enabling technologies include: virtual prototyping and advanced modeling to radically change the DoD acquisition process through integrated product and process design; integrated ship sensor, weapons and platform technologies to demonstrate the feasibility of reduced ship manning; and Command, Control, Communications, and Intelligence/Synthetic Environments (C3I/SE) for littoral warfare.

(U) The Simulation-based Design (SBD) area is developing and demonstrating a prototype infrastructure that will enable a significant positive change in the acquisition process for large, complex warfighting systems. SBD will utilize virtual prototypes in synthetic environments to enable effective, integrated product and process development. The program will integrate the technologies of distributed interactive simulation, physics-based modeling, and virtual environments and apply them to the design, acquisition, and life cycle support processes of systems. Complete simulation from early in the concept formulation stage through verification of requirements to design, manufacture, operation, training, and logistics will be available prior to initiation of construction. Successful development and deployment of SBD will enable meeting the program's objective of reducing the cost and acquisition time for DoD systems. Overall product quality and capabilities will be enhanced by the timely insertion of the latest technological advances into designs as they progress through the shortened acquisition cycle. SBD will be applicable to a broad range of system domains including land vehicles, aircraft, satellites and marine vehicles. SBD will be applicable to all subsystems, from mechanical to large scale electronic, within an overall system and it will enable cost savings by reducing the need for expensive physical mockups and by eliminating many of the manufacturing inefficiencies caused by inadequate design.

(U) In the Ship Systems Automation (SSA) area, advanced, highly automated sensor, weapons control, and platform systems (including damage control) are being developed and demonstrated for submarine and surface ship applications. Through evolving sequential technology demonstrations, efforts in this area will show how an integrated collection of automated systems could achieve an order of magnitude reduction in crew size. Because personnel account for a significant portion of current ships' life cycle costs, such a reduction would lead to immediate and long term cost savings for ship acquisition programs. SSA technology developments include intelligent command-level advanced reasoning components, scalable sensor integration work stations to fuse multi-source data and intelligently display the tactical scene on a situation assessment system, cooperating expert agents conducting mission-

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology, PE 0602702E, Project TT-03

context/sensor employment planning, and integrated internal condition sensor and control systems to intelligently display and control ship physical conditions on a ship's internal assessment system.

(U) In the C3I/SE area, advanced information technologies are being integrated and applied to provide improved battlefield awareness and battlefield dominance to mobile command centers in the field (e.g., Force Commanders, Commander Joint Task Force (CJTF), and deployed Joint Special Operations Task Force (JSOTF) Commanders). The advanced prototype systems developed under this program integrate the latest technologies in high-bandwidth communications, object oriented information system, collaborative planning, intelligent database access, image processing, data exploitation, and high performance computing to address the unique (quick reaction and real-time execution) requirements of forward deployed, mobile commanders. The demonstration systems will include capabilities for high-bandwidth communications to ships and aircraft at sea based on capitalizing upon emerging commercial and military communications advancements. It also develops the Synthetic Test Range (STR), which in conjunction with the Simulation Based Design (SBD) development, is aimed at improving the acquisition process. The STR will conclude in FY 1996 and transition to Naval Sea Systems Command. The Command, Control, Communication, and Intelligence/Synthetic Environment (C3I/SE) Program builds upon existing DARPA-developed planning tools while identifying and incorporating other emerging C3I and information system technologies. Starting in FY 1996, the program is emphasizing collaborative crisis understanding and mitigation developing tools and systems necessary to recognize, understand, forecast, and defuse potential crisis situations. This effort will be focused on National Command Authority, National Security Council, and National Military Command Center.

(U) **Program Accomplishments and Plans:**

(U) FY 1995 Accomplishments:

- Commenced SBD prototype development and initiated applications demonstrations using the facilities of linked design centers. ($15.1M)
- Initiated creation of a virtual prototype of a large complex mechanical and electronic system for application and analysis. ($3.2M)
- Initiated demonstrations of SBD critical enabling technologies. ($5.4M)
- Conducted a demonstration of a concept for electronic commerce supporting distributed facilities manufacturing complex systems. ($1.0M)
- Demonstrated an initial integrated Command, Control, Communication, and Intelligence/Synthetic Environment (C3I/SE) architecture during exercise Kernel Blitz in an amphibious assault and a maritime theater-wide planning/planning assessment scenario linked to an at-sea Commander Joint Task Force (CJTF) during Joint Warfare Interoperability Demonstration (JWID-95). Conducted a mobile demonstration of advanced technology

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology, PE 0602702E, Project TT-03

wideband satellite network communications between the Commander-in-Chief (CINC) and mobile CJTF command complexes during JWID-95. ($6.7M)

- Expanded synthetic environment development to include a complete electromagnetic environment creating a Test Range (STR). ($2.2M)
- Conducted Ship Systems Automation (SSA) demonstrations of Intelligent Systems Interfaces Concepts, Advanced Tactical Planning and Electronic Warfare Advisor in the combat systems area; demonstrated a manpower assessment tool concept. ($8.0M)
- Continued most promising ocean science efforts at the Center of Excellence for Research in Ocean Sciences (CEROS). Selected several innovative marine technology projects for initiation. ($6.9M)

(U) FY 1996 Program:

- Conduct Simulation-Based Design (SBD) prototype demonstrations on a complex application at distributed design and visualization centers linked via nationwide wideband networks; one to be a joint demonstration in support of the Defense Modeling and Simulation Office High Level Architecture. Conduct a demonstration of a virtual prototype of a ship combat system using an electronic smart product model to demonstrate functional requirements. ($10.0M)
- Initiate expansion of SBD through application to development programs of small rapid satellite manufacturing, selected aircraft sub-system manufacturing, land vehicle power train design, and ship manufacturing enterprise. ($4.9M)
- Conduct high fidelity radar stimulation with an operational radar system, transition to Navy users. ($2.5M)
- Initiate collaborative crisis understanding and mitigation effort, develop concept of operations and visualization demonstration emphasizing data mining, modeling and collaboration in response to pre-crisis indicators. ($2.5M)
- Conduct demonstration and testing of campaign operations planning system applied to joint forces command and control in a deployable package. ($2.7M)
- Demonstrate advanced Ship Systems Automation (SSA) technologies which enable a few operators to collaborate with advanced-reasoning systems to manage the construction of a complex multi-warfare, multi-sensor fusion tactical scene and the effective operation of a combatant ship in that scene. Intelligent System Interface and advanced sensors technologies will continue to be developed and demonstrated. ($10.0M)
- Continue most promising ocean sciences efforts at the Center of Excellence for Research in Ocean Sciences (CEROS). Select several innovative marine technology projects for initiation. ($6.9M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology, PE 0602702E, Project TT-03

(U) FY 1997 Program:

- Conduct interim Simulation Based Design (SBD) prototype demonstrations of multi-disciplinary engineering analysis with connectivity to manufacturing. ($11.8M)
- Conduct interim demonstrations of SBD enabling critical technologies in system architecture, high performance computing, human computer interfaces, and design and manufacturing processes. ($3.6M)
- Conduct crisis detection and alertment demonstrations at Intelligence and Military Command Centers sites. ($7.7M)
- Conduct an advanced reasoning systems land-based demonstration in which all Ship Systems Automation (SSA) work collaboratively with a few operators to monitor and control all conditions within the ship (including damaged response) and to fight effectively in a complex tactical scenario. ($9.5M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	49.4	39.7	55.9
Appropriated	48.8	51.0	N/A
Current Budget	48.5	39.5	32.6

(U) **Change Summary Explanation**:

FY 1995 Minor program repricing. ($.3 million)
FY 1996 Decrease reflects a reduction for the Bosnia reprogramming ($.4 million); the consolidation of transportation technologies in Project TT-10 ($9.7 million) and the reprioritization and transfer of funding to small low-cost interceptor effort in TT-04. ($1.4 million)
FY 1997 Decrease reflects the consolidation of transportation technologies in Project TT-10 ($17.2 million); reduction for DoD inflation adjustments ($2.0 million) and program repricing. ($4.1 million)

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: March 1996
APPROPRIATION/BUDGET ACTIVITY: RDT&E, Defensewide; BA 2 Applied Research	R-1 ITEM NOMENCLATURE: Tactical Technology, PE 0602702E

COST (*In Thousands*)	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Advanced Land Systems Technology TT-04	28,335	35,670	22,125	19,000	30,000	33,909	51,686	Continuing	Continuing

(U) **Mission Description:** This project is intended to develop technologies for contingency missions and military Operations-Other-Than-War (OOTW) to make U.S. combat forces more deployable, effective, survivable, and affordable. This project supports five main efforts: Small Low-Cost Interceptor Device (SLID); the Foreign Cooperative Demonstration; Small Unit Operations; OOTW and OOTW/Law Enforcement; and Unexploded Ordnance Detection and Neutralization.

(U) The SLID program will develop and test a system for providing protection against missiles and projectiles with explosive warheads. This sytem will detect, track and intercept these threats at a standoff distance sufficient to render them ineffective. Applications for the SLID system include: self-defense of vehicles; high value fixed sites such as command centers, parked aircraft and radars; and may be extended to low-speed aircraft.

(U) The Foreign Cooperative Demonstration program will fabricate and demonstrate a new system for enhancing the survivability of armored vehicles based on technology developed from a foreign source.

(U) The Small Unit Operations (SUO) program will develop the key technologies to enable more capable, dispersed military units to effectively perform warfighting operations traditionally accomplished with larger, massed forces. The SUO program focuses on enabling comprehensive awareness at the tactical level in restrictive environments. Sniper/mortar detection, hyperspectral infrared mine detection, and thru-wall detection work initiated under the OOTW program will be continued with an emphasis on small unit operations. In FY 1997 these SUO efforts will be realigned in Project EE-51.

(U) Military OOTW encompass a wide range of activities where military power is used for purposes other than large scale combat. The purpose of the DARPA OOTW research and development program is to develop and demonstrate technologies that will enhance the survivability of individual soldiers and military units engaged in OOTW. These technologies also have application to general military operations and civilian law enforcement. DARPA will focus on solutions that will improve our ability to conduct OOTW missions through affordable, advanced technologies. Technology developments are being conducted in areas such as personnel armor; limited effects technology; concealed weapons detection; automatic language interpretation/translation; geo-location, navigation, an data transfer subsystems. Those technologies that minimize response time to achieve mission goals will be emphasized. Funding of

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology, PE 0602702E, Project TT-04

this program will be completed in FY 1996. Successful technologies will be transitioned to the Military Services, Civilian Law Enforcement Agencies, and the Small Unit Operations Project (mine/unexploded ordnance detection development will continue under Project TT-04).

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Completed Phase I (risk reduction) efforts in the Small Low-Cost Interceptor Device (SLID) program and performed downselection for Phase II fabrication and testing. ($9.6M)
- Operations-Other-Than-War (OOTW) and Law Enforcement OOTW ($18.7M):
  - Completed initial demonstrations of Soldier 911 systems in Macedonia and Korea.
  - Initiated concept design for Superchip.
  - Continued mine/unexploded ordnance detection development and performed preliminary field test of miniature hyperspectral IR sensor.
  - Initiated development and conducted initial demonstration of English to Korean text translation.
  - Completed phenomenology study for through-the-wall surveillance and concealed weapons detection and awarded development contracts on BAA.
  - Awarded contracts for sniper detection system.

(U) FY 1996 Program:

- Initiate SLID phase II fabrication and testing effort with remaining contractors. Perform sub-system tests leading to static system tests. ($13.2M)
- Operations-Other-Than-War (OOTW) ($7.4M):
  - Complete the Soldier 911 demonstrations in Korea and Macedonia, and the Korean/English text translator.
  - Complete modular tag concept definition phase.
  - Continue mine/unexploded ordnance detection technology development, including chemically-specific detection techniques.
  - Demonstrate the Korean/English speech translator, the concealed weapons system, extremity armor, and limited effects technology.
- Initiate development of the system for the Foreign Cooperative Demonstration. ($2.0M)
- Continue development of sniper, mortar, hyperspectral infrared mine, and thru-wall detection technologies with emphasis on small unit operations. ($13.1M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology, PE 0602702E, Project TT-04

(U) FY 1997 Program:

- Continue Small Low-Cost Interceptor phase II effort. Conduct full system static tests and tests against slowly moving targets. Prepare for live-on-live tests. ($12.1M)
- Complete the Foreign Cooperative Demonstration testing and transition program to the Army. ($2.0M)
- Continue chemically-specific unexploded ordnance/mine detection technology development, evaluate advanced algorithms and sensor fusion capabilities for multiple-sensor UXO/mine detection, and investigate alternative interrogation and neutralization approaches. ($8.0M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	30.2	34.1	26.0
Appropriated	29.3	33.2	N/A
Current Budget	28.3	35.7	22.1

(U) **Change Summary Explanation**:

FY 1995 Minor program repricing.
FY 1996 Funding changes reflect the reduction for Bosnia reprogramming of .3 million and minor repricing.
FY 1997 Decrease reflects transition of Operations Other than War programs to Small Unit Operations (Project EE-51).

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology, PE 0602702E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Advanced Tactical Technology TT-06	36,409	38,624	45,995	50,553	56,418	57,024	62,728	Continuing	Continuing

(U) **Mission Description:** This project focuses on the technology and applications of compact lasers, microwave radiation sources, advanced displays and mathematical algorithms for signal and image processing and modeling and simulation of nonlinear processes to dramatically improve the performance of radar, sensors, and systems for electronic warfare, target recognition, and military communications. Nine broad technology areas are being investigated: (a) compact, efficient, frequency-agile, diode-pumped, solid-state lasers for infrared countermeasures, laser radar and sensors; (b) miniature air-launched decoy systems; (c) compact high density data storage for high bandwidth image processing; (d) high performance, pulsed radio frequency (RF) radiation sources for smaller and better microwave tubes; (e) fast computational algorithms for signal processing, target recognition and tracking, electromagnetic and acoustic propagation in nonlinear media, materials, and microelectronics processing; (f) passive infrared signature suppression to counter air-to-air missile threats; (g) precision optics components for critical DoD applications; (h) vectored thrust testing; and (i) tactical landing systems.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Compact Lasers ($5.0M): Demonstrated breadboard systems of compact high power lasers at a wavelength near one micron, tunable mid-infrared lasers, and aluminum free laser diode arrays.
  - Demonstrated 10 Joules of energy at 50 Hertz in 10 nanosecond pulses and at a wavelength of one micron and frequency doubled to 0.532 micron with near diffraction limited beam quality.
  - Demonstrated tunable mid infrared lasers with waveform modulation for U.S. Army advanced threat infrared countermeasures program.
  - Demonstrated aluminum free laser diodes at 0.808 microns and 0.980 microns in both continuous wave and quasi-continuous wave outputs.
- Holographic Data Storage ($6.1M): Technology demonstration of page-format, high density input and readout capability.
  - Developed systems architecture for 1 terabit capacity and fast readout of data.
- Pulsed Radio Frequency (RF) ($6.2M): Continued fabrication and integration of advanced RF amplifiers and power combining techniques.
  - Fabricated triode amplifier using microcathode operating at 10 gigahertz (GHz).

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology, PE 0602702E, Project TT-06

- Designed and fabricated prototype high performance 94 GHz power amplifier.
- Demonstrated a high frequency power combining technique using solid state devices operating at 44 GHz.
- Designed reconfigurable antenna using microtip and diode laser technology.

• Fast Computational Algorithms ($11.4M):
- Developed methods for multiresolution synthetic aperture radar and adaptive waveform design.
- Applied wavelet design tools to tactical communications and target recognition.
- Demonstrated image denoising and segmentation algorithms derived from nonlinear partial differential equations.
- Demonstrated fast multipole radar cross section code with an order-of-magnitude increase in capability.
- Developed simulation tools, signal processing and modern control methods for the in-situ sensing and real-time control of materials and microelectronics processing.

• Miniature Small Engine Application Program (SENGAP) turbine engine ($3.6M): Validated the SENGAP engine through successful flight worthiness verification and actual flight tests.

• Advanced Infrared Signature Suppression ($1.9M):
- Phase 2:
  -- Bench tested cooling system concept, thermodynamics of the system and the absolute value of the skin temperature.
  -- Documented results in Phase 2 final report.
- Phase 3:
  -- Designed cooling panel for NASA F-15 Pod.

• Vectored Thrust ($2.2M): Initiated test efforts of cascade vectored thrust and block and turn vectored thrust lift systems for application in transport aircraft.

(U) <u>FY 1996 Program</u>:

• Compact Lasers ($7.0M): Demonstrate compact lasers and active tracking systems at mid-infrared wavelengths for IR countermeasures.
- Demonstrate mid-infrared lasers, packaged for slow motion, dynamic testing.
- Demonstrate and test a compact active tracking system brassboard for mid-infrared wavelengths.

• Holographic Data Storage ($5.9M): Technology demonstration to establish system trade-offs of various candidate materials for holographic data storage.
- Demonstrate proof-of-principle digital holographic data storage devices to establish the capability of various multiplexing methods and error detection and correction schemes.

• Fast Computational Algorithms ($14.4M):
- Demonstrate wavelet-based methods for automatic target detection and recognition.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology, PE 0602702E, Project TT-06

- Demonstrate multiresolution methods and adaptive waveforms for image formation and processing.
- Develop hybrid automatic target recognition strategy for synthetic aperture radar exploiting most advantageous features of both wavelets and nonlinear partial differential equation-based methods.
- Develop 3D implementation of fast multipole method for radar cross section calculations.
- Identify approaches to reducing high-order nonlinear descriptions of thin film processes to real-time sensing and control models.

• Precision Optics Technology ($3.3M): Develop conformal and off-axis optical components for next generation tactical systems using computer-aided design and manufacturing.

• Advanced Infrared Signature Suppression ($1.1M): Integrate and demonstrate (flight test) a long-wave infrared (LWIR) suppression system.

• Tactical Landing System ($6.9M): Develop and demonstrate a low-cost, off-the-shelf, militarized, rapidly deployable, transportable, precision landing system.

(U) FY 1997 Program:

• Compact Lasers ($6.7M): Demonstrate breadboard systems of compact high power tunable mid-infrared lasers, and laser diodes at mid-infrared wavelengths.
  - Demonstrate breadboard tunable mid-infrared lasers with a watt output at 20 kilohertz (KHz) pulse repetition rate for ship defense.
  - Demonstrate mid-infrared laser diodes.

• Holographic Data Storage ($4.9M): Technology demonstration to establish functional limits.
  - Demonstrate 1 terabit storage capacity for functional evaluation of write once and read many (WORM) type storage systems.

• Fast Computational Algorithms ($24.2M): Continue transition of novel algorithms for automatic target recognition and image processing and develop associated electromagnetic and acoustic propagation models. Begin development of models of thin film processes that integrate process, sensing, and control considerations and provide understanding of critical microstructure issues needed to design high-quality and high yield manufacturing processes.
  - Select automatic target recognition algorithms for system insertion demonstrations.
  - Apply adaptive waveform designs to radar and communication.
  - Implement a hybrid automatic target recognition strategy for synthetic aperture radar exploiting most advantageous features of wavelets and nonlinear partial differential equation-based methods.
  - Demonstrate orders-of-magnitude speed-up provided by parallel implementation of fast multipole techniques to radar cross section calculations.
  - Develop methods for calculating electromagnetic scattering from objects in ground clutter.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology, PE 0602702E, Project TT-06

- Develop sensing and control models for thin film processes.

• Precision Optics Technology ($7.0M): Continue development of conformal and off-axis optical components for tactical systems.
  - Develop magneto-rheological finishing for aspheres, toroids and cylinders.
  - Demonstrate near net shape conformal window fabrication.
• Miniature Air-Launched Decoy (MALD) ($3.0M): Begin MALD system design, engineering and producibility analysis.
• Complete analysis and risk reduction testing to validate key technologies for Vectored Thrust concepts. ($.2M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	36.2	39.4	42.8
Appropriated	35.2	39.5	N/A
Current Budget	36.4	38.6	46.0

(U) **Change Summary Explanation**:

FY 1995 Increase reflects minor program repricing.
FY 1996 Decrease reflects Virtual Integrated Prototyping, ($+1.5 million); offset by Bosnia reprogramming action, ($-2.4 million).
FY 1997 Increase reflects minor program repricing.

(U) **Other Program Funding Summary Cost**:

FY 1997 Advanced Concept Technology Demonstration Funding for MALD. PE 603757D.

(U) **Schedule Profile**: N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology, PE 0602702E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Advanced Logistics Technology TT-10	0	6,399*	17,185	28,685	16,665	7,633	0	0	N/A

* This ST-11 effort also includes Advanced Logistics efforts included under PE 0602301E.
4,262

(U) **Mission Description:** The Advanced Logistics Program (formerly TransTech) will investigate and demonstrate technologies that will make a fundamental difference in transportation and logistics. The Advanced Logistics Program will define, develop, and demonstrate fundamental enabling technologies that will permit logistics and transportation assets to be deployed, tracked, refurbished and redeployed more efficiently than ever before. Currently, these assets are being managed using isolated, independent, and sometimes incompatible computer systems. Therefore, the very rapid replanning and redirection necessary to support missions involving simultaneous local and major regional conflicts cannot be accomplished today. The Advanced Logistics Program will enable this significant capability to be developed. In addition, the project has enormous potential for cost savings through greatly improved management of transportation and logistics assets.

(U) The Advanced Logistics Program will develop multi-echelon, collaborative logistical/transportation support tools that will provide warfighters an unprecedented capability to monitor, rapidly replan and re-execute movement, even while enroute to the theater. The Advanced Logistics Program will focus on three areas: 1) Development of a computer network infrastructure that allows distributed real-time visualization and interaction with all phases, elements and components of the military and commercial transportation infrastructure; 2) Development of applications providing a technology environment that allows warfighters to rapidly understand and assess the logistics and transportation implications of a crisis situation, to generate effective plans and courses of action, to monitor a plan's execution, and to use that information to re-plan; 3) Systems that will enable significant efficiency improvements in transportation and logistics, such as automatic equipment identification and tracking (tags), and improved theater distribution. The capabilities from these three areas will be integrated to demonstrate an end-to-end system solution.

(U) **Program Accomplishments and Plans**:

(U) FY 1996 Program:

- Initiate development of a distributed logistics and transportation network including development of information manipulation and planning tools to support planning, execution, monitoring and focused replanning throughout the logistics pipeline. ($4.9M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology, PE 0602702E, Project TT-10

- Investigate technology opportunities for data gathering and measurement of the logistics execution environment including data gathering tools for semi-autonomous capture, search and retrieval of data in disparate defense and commercial logistics sources and advanced tagging/locating/measurement sampling systems and software. ($1.5M)

(U) FY 1997 Program:

- Continue architecture development and demonstrate a distributed logistics planning, execution, and monitoring system concept to support inland military logistics planning/replanning from origin to port. ($6.0M)
- Conduct a feasibility demonstration of advanced tagging/locating/measurement sampling systems and software. ($3.0M)
- Initiate proof of principle for advanced software data collection techniques (also referred to as knowledge rovers or intelligent software agents) that search the Global Information Infrastructure for relevant logistics information and data and return it to the user. Initiate development of multi-echelon collaborative logistical support tools that integrate planning, execution, monitoring and decision support systems for testing and deploying these tools. Develop an integrated software framework that is reusable and reconfigurable. ($8.2M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	0	0	0
Appropriated	0	0	0
Current Budget	0	6.4	17.2

(U) **Change Summary Explanation**:

1997 Reflects the consolidation of transportation technologies from Strategic Competing and Naval Warfare Technology into a new project for greater visibility.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Integrated Command and Control Technology, PE 0602708E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
High Definition Systems IC-03	79,375	48,342	45,000	45,000	45,000	45,000	45,000	Continuing	Continuing

(U) **Mission Description:** This program element is budgeted in the Applied Research Budget Activity because it develops the technology and manufacturing capability for high definition displays and is important for virtually all DoD applications that involve visual and graphic information. Major components of this program include: projection, head mounted and direct view displays based on multiple technologies; development of equipment and components required to manufacture advanced display technologies, and prototype display systems for system evaluation. These efforts will establish a domestic technical capability and demonstrate the manufacturing capability of components necessary for military systems that capture, process, store, distribute and display high resolution images.

(U) **Program Accomplishments and Plans:**

(U) FY 1995 Accomplishments:

- Continued development of flat panel and projection displays for aircraft cockpit applications, mobile computing displays, and shipboard and landbased command and control centers. ($36.4M)
- Continued enabling material and component technologies for performance and cost goals for liquid crystal materials, polymer electroluminescent materials, lightweight optics, color filters, flat backlights, field emitter materials and structures, and phosphors. ($12.0M)
- Developed manufacturing equipment and processes for the affordable production of high definition displays. Flat panel display manufacturing equipment have been scaled up to handle larger substrates at higher throughputs with improved process capability. ($20.0M)
- Developed displays with integrated computation and image processing and develop improved phosphor materials and deposition processes for emissive displays (electroluminescent, field emission and plasma displays). ($11.0M)

(U) FY 1996 Program:

- Continue development of flat panel and projection displays for mobile displays, and shipboard and landbased command and control centers. ($19.3M)
- Continue development of equipment and components to meet display cost and performance goals. This will include efforts in patterning, film deposition and annealing, and field emission display materials and

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Integrated Command and Control Technology, PE 0602708E, Project IC-03

assembly tools, as well as reflective liquid crystal materials and phosphor technology development. ($21.0M)

- Develop system prototypes which leverage earlier developed display technologies and incorporate integrated systems and intelligent interfaces. ($8.0M)

(U) FY 1997 Program:

- Continue development of reflective and emissive mobile display technologies and laser based projection systems for command and control applications. ($13.0M)
- Continue development of equipment and components to meet display cost and performance goals. This will include efforts in patterning and field emission display materials and assembly tools, as well as reflective liquid crystal materials, phosphor technology development, and support for domestic display manufacturing infrastructure. ($22.0M)
- Continue development of system prototypes which leverage earlier developed display technologies and incorporate integrated systems and intelligent interfaces. ($10.0M)

U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	81.6	48.0	67.6
Appropriated	79.8	48.7	N/A
Current Budget	79.4	48.3	45.0

(U) **Change Summary Explanation**:

FY 1995 Reflects minor program repricings.
FY 1996 Decrease reflects reprogramming action in support of Bosnia.
FY 1997 Reflects reprioritization of DoD resources.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: March 1996
APPROPRIATION/BUDGET ACTIVITY: RDT&E, Defensewide; BA 2 Applied Research	R-1 ITEM NOMENCLATURE: Materials and Electronics Technology, PE 0602712E

COST (In Thousands)	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Materials and Electronics Technology	**259,792**	**235,159**	**218,539**	**267,025**	**285,756**	**302,725**	**312,708**	**Continuing**	**Continuing**
Materials Processing Technology MPT-01	140,900	120,350	110,208	137,414	142,491	146,550	150,327	Continuing	Continuing
Microelectronic Device Technology MPT-02	87,440	57,597	71,824	87,157	95,396	99,222	98,881	Continuing	Continuing
Cryogenic Electronics MPT-06	16,820	28,942	9,835	11,240	10,183	12,546	15,000	Continuing	Continuing
Military Medical/Trauma Care Technology MPT-07	14,632	28,270	26,672	31,214	37,686	44,407	48,500	Continuing	Continuing

(U) **Mission Description**: This program element is budgeted in the Applied Research Budget Activity because its objective is to develop technology related to those materials, electronics, and medical devices that make possible a wide range of new military and commercial capabilities.

(U) The Materials Processing Technology project (MPT-01) concentrates on the development of novel affordable materials, processing techniques, and fabrication strategies for production of higher performance advanced structural, electronic, and magnetic materials manufactured at a lower cost. A major area of concentration is the application of process modeling, mathematical simulation, sensors, and advanced control to materials processing, thin film processing, large area multichip module processing, and flexible fabrication and assembly. It includes research on composite materials, synthesis of diamond films; high temperature semiconductors; insertion of ceramics into military system components; flexible solid freeform fabrication; toxic waste elimination; modeling and simulation of vapor phase processing of thin film materials; cryogenic electronics; adaptive ("smart") materials and structures; and magneto-resistive materials.

(U) The Microelectronics Device Technologies project (MPT-02) develops advanced electronic and optoelectronic devices, semiconductor process tools and methodologies, materials for optoelectronics and infrared devices. Areas of emphasis include high-performance analog-to-digital converters, military optical processors, novel optoelectronic devices, artificial neural network technology, low power electronics, non-volatile memory, digital radar processor components, electromagnetic interference semiconductor susceptibility, high temperature electronic devices, and high power electronics.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E

(U) In the Cryogenic Electronics project (MPT-06), thin film electromagnetic material have reached a stage of development where specific applications can be identified in electronic devices and circuitry for military applications. Thin-film high temperature superconducting components packaged with cryogenic devices are being applied to radars, electronic warfare suites, and communications systems to enhance performance while reducing size and power requirements. Highly dependable and inexpensive cryocoolers are being developed for these applications, and new efforts will explore techniques to improve cryogenic performance in applications ranging from communications to computing.

(U) Military Medical/Trauma Care Technology project (MPT-07) is an initiative to significantly improve far-forward battlefield trauma care. The Advanced Biomedical Technology portion focuses on the human factors of advanced technology concepts in a front-line battlefield environment through development of body-worn monitors, field-portable digital imaging equipment, and battlefield surgical simulator. The Health Care Information segment concentrates on development of physician, medic, and community information associates for utilization by both medics during combat care scenarios and physicians during patient visits.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Materials Processing Technology MPT-01	140,900	120,350	110,208	137,414	142,491	146,550	150,327	Continuing	Continuing

(U) **Mission Description**: The major goals of this project are to develop novel affordable materials, processing techniques, and fabrication strategies for the production of advanced structural, electronic and magnetic materials and components and devices for application in military platforms and systems for improved performance and at lower processing costs. This is accomplished by awards to individual companies, universities, and government laboratories, as well as by cost-shared Advanced Materials Partnerships. A major area of concentration is the application of process modeling, mathematical simulation, sensors, and advanced controls to materials processing, thin film processing, large area multichip module processing, and flexible fabrication and assembly. Other predominant areas include: research on composites (metal matrix, polymer matrix, ceramic matrix, and carbon-carbon) for advanced aerospace structural materials to upgrade gas turbine engine and airframe components; synthesis of diamond films for thermal management in electronic packaging; high temperature semiconductors, such as silicon carbide for high power applications in aircraft and electric vehicles; insertion of state-of-the-art ceramics into military system components (bearings, gas turbine engine components); removal of biological weapons threats through real-time, pre-exposure detection, discrimination, and identification of the threat; and precision machining of high strength alloys, composites, and ceramics using laser and electron beam energy sources. Sensors and techniques will be developed for improved intelligent processing of materials. Magneto-resistive materials will be developed for demonstration of non-volatile radiation hardened magnetic memories with very high density, short access time, infinite cyclability and low power and for sensors in smart materials actuator systems.

(U) Flexible solid freeform fabrication capabilities are being developed for high performance structural materials (especially ceramics) and aerospace alloys, which will fabricate functional components directly from Computer Aided Design (CAD) files and not require part-specific tooling or operator intervention. Environmental research includes the development of DoD-related toxic waste elimination and "green" manufacturing processes, which seek to eliminate or minimize toxic waste produced by fabricating products relevant to the DoD.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-01

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Biotechnology ($1.9M): The basic research portion of this effort is found under PE 0601101E, Project MS-01. Completed program and transitioned to Advanced Biomedical Technology Program. (PE 0601101E, Project MS-01 and 0602712E, Project MPT-07).
  - Demonstrated gain of a biosensor device by modulation of intrinsic cellular amplification system (second messenger system).
- Structural Materials ($64.5M): Developed affordable composites, ceramics, and alloys using intelligent processing of materials and automated manufacturing concepts. Emphasized insertion of components into military systems.
  - Demonstrated on-line sensing of critical product and process variables and multivariable feedback control for the rapid densification manufacturing process for carbon-carbon composites.
  - Developed advanced electron beam curing process suitable for production of polymer matrix composites.
  - Developed cost effective electron beam processing technology for silicon carbide fiber reinforced titanium for turbine engine components.
  - Initiated program to develop ultra lightweight structural panels for missile and aircraft construction.
  - Initiated a program to develop lightweight aluminum-beryllium aircraft and turbine engine structures.
  - Initiated cost-shared Advanced Materials Partnerships (consortia) in the areas of polymer composites and advanced non-destructive evaluation of structural materials.
- Material and Device Fabrication ($25.2M): Extended program to address hard and soft tooling, laser cutting and processing capabilities, large format multi-chip modules, and solid freeform fabrication.
  - Developed prototype design for adaptively-controlled machine tools, including a control scheme to correct machine errors.
  - Developed and applied sensor technologies for on-line process control of the large-format and roll-to-roll unit processing tools identified for development of multi-chip modules.
  - The laminate multichip module pilot line was installed and demonstrated all unit processes; debugging and process improvement studies are continuing.
  - Utilized selected laser sintering and 3-D printing solid free-form fabrication to demonstrate structural ceramic and metal components with strengths comparable to what can be produced using mass production methods.
  - Developed and applied fiber optic sensors to powder burnout and consolidation processes.
- Advanced Materials and Processing ($31.5M): Continued processing developments for affordable materials.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-01

- Lowered defect density in semiconducting silicon carbide boules to optimize electrical properties and increase yield.
- Developed computer models for plasma spraying of metal matrix composites.
- Developed shape memory alloy and electrostrictor ceramic actuators for smart structure applications.
- Developed integration technology to produce smart structures containing sensors, actuators, and on-board electronics for real time control of noise, vibration, and small scale shape change.
- Developed and demonstrated a "slotted" metal chamber which effectively couples Radio Frequency (RF) energy to generate a plasma sheath around the chamber walls for Chemical Vapor Deposition (CVD) diamond growth.
- Developed theoretical and computational methods to predict structural and electro-optic properties of semiconductor superlattices.
- Successfully reduced defect density in Gallium Nitride (GaN) material system and demonstrated the first U.S. very bright blue light emitting diodes with 1200 microwatts of optical power.

• Vapor Phase Processing ($10.0M): Develop intelligent processing technologies to scale-up cost-effective production of thin film photovoltaics, multilayer turbine engine coatings, and thin film high temperature superconductor devices.
- Demonstrated on-line sensing to measure critical process and product variables in the production of thin film functional multilayer structures.
- Preliminary process models were constructed to demonstrate reactive co-evaporation systems and metal-organic chemical vapor deposition growth of high temperature superconducting thin films.
- Field demonstrated with the 7th Marines a high efficiency, foldable photovoltaic power source for re-charging hand-held radio batteries.
- Demonstrated feasibility of an on-line laser atomic adsorption spectrophotometer for sensing vapor species during electron beam physical vapor deposition production of multilayer thermal barrier coating systems.

• Environmental Sciences ($7.8M): Destroy DoD toxic waste using supercritical water oxidation (SCWO). Reduce toxic waste production as by-products of DoD-related fabrication processes ("green" manufacturing).
- Initiated research and development of transportable supercritical water oxidation (SCWO) system capable of processing 100 lbs/hr of Navy shipboard excess hazardous materials.
- Developed alternative electronic manufacturing processes for minimization/elimination of toxic wastes.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-01

(U) FY 1996 Program:

- Structural Materials. ($27.4M)
  - Demonstrate full-scale rapid densification of carbon-carbon composite components.
  - Demonstrate a five-fold improvement in the life of the roll reaction control (RRC) valve bearings on the AV-8B Harrier aircraft due to the upgrade of the metal bearings with ceramic hybrid bearings.
  - Validate the Resonant Ultrasonic Inspection technique for ceramic rolling elements through beta site testing at a commercial ball bearing finisher.
  - Demonstrate production of voided and foamed aluminum and titanium core materials for ultra lightweight panels.
  - Demonstrate low cost aluminum-beryllium aerostructure fabrication processes.
  - Demonstrate reduced mean-time-between-failure (MTBF) associated with the upgrade of glass optical domes to spinal domes used in the Angle Rate Bombing Set (ARBS) of the AV-8B Harrier aircraft.
  - Initiate new Advanced Materials Partnerships in low cost metals processing and advanced ceramics.
- Material and Device Fabrication. ($27.3M)
  - Demonstrate prototype multichip modules (MCM) with laminate technology roll to roll processing.
  - Demonstrate a prototype MCM for a missile guidance section using a bare die on a laminate substrate and electronically validate performance.
  - Demonstrate the use of X-ray tomography and develop software to generate CAD files from solid objects compatible with requirements of solid freeform fabrication.
  - Develop the machine capability to produce silicon nitride components using the fused deposition method with silicon nitride powder loaded wax filaments.
  - Demonstrate the capability to fabricate molds for slip casting structural ceramics using the 3-D printing technology.
  - Demonstrate application of smart materials to reconfigurable machines and tooling hardware.
  - Analyze smart materials applications for submarines.
  - Demonstrate an advanced polarization preserving fiber optic connector.
- Advanced Materials and Processing. ($35.0M)
  - Develop a Chemical Vapor Deposition (CVD) process for the fabrication of particulate and chopped fiber reinforced composites with a 10X increase in composite growth rate over normal CVD processing; and demonstrate the utility of the fabricated composites for the die casting of copper alloys.
  - Design, fabricate and evaluate fiber reinforced ceramic matrix composite fins for the Army's Line of Sight Anti-Tank (LOSAT) missile with a 50% weight savings over the current materials (primarily steel).
  - Develop magnetoresistive materials with improved electrical resistance properties.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-01

- Develop simulation codes for the physics of vapor deposition and validate on industrial processes.
- Develop feedback control methods for plasma sprayed metal matrix composites.
- Demonstrate a process to produce elastomeric electrorheological materials for acoustic wave filtering applications.
- Demonstrate diamond manufacturing cost reduction of a 1/2″ X 1/2″ square substrate to $5/piece.
- Demonstrate greater than 50 fold increase in Chemical Vapor Deposition (CVD) diamond deposition rate (from 60 mg/hr to greater than 3000 mg/hr) with a large area and high rate deposition system.
- Demonstrate the advantages of thermal management diamond in defense applications (e.g., high-power transmit-receive modules, Electronic Warfare Systems).
- Develop stable contacts for high temperature, high power semiconductors.
- Demonstrate material sensor and activator components manufacturability utilizing piezoelectric ceramics and electrostrictors.

• Vapor Phase Processing. ($11.3M)
- Demonstrate on line sensing and closed loop control of thin film photovoltaic processing.
- Demonstrate an order of magnitude improvement in jet engine compressor blade erosion resistance through the use of multilayer coatings.
- Demonstrate high yield large area processing of thin film high temperature superconducting devices.

• Environmental Sciences. ($9.3M)
- Design and initiate construction of a supercritical water oxidation system for shipboard excess hazardous material disposal.
- Demonstrate more environmentally sound production processes for printed wiring boards.
- Initiate studies of advanced erosion/corrosion resistant thin film coatings.

• Biological Warfare Defense. ($7.8M)
- Develop integration technology to insert up-converting phosphors into existing biological warfare agent sensors.
- Demonstrate feasibility of aflatoxin biosensor.
- Develop crystallization procedures for spore germination enzymes.
- Design microfabricated polymer bilayer air-fluid sampling inlet.
- Determine performance characteristics of biological sensors in multiple environments.
- Identify and purify target enzymes for inhibition of spore germination.
- Develop reference architecture for smart messages system.

• Magnetic Materials and Devices. ($2.3M)
- Develop giant magneto-resistive (GMR) films with enhanced electrical characteristics.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-01

- Enhance magneto-resistance ratio at low magnetic fields for faster response and higher sensitivity of devices.
- Model magnetic memory cell design.

(U) FY 1997 Program:

- Structural Materials. ($36.6M)
  - Demonstrate a 2X increase in mean-time-between-failures (MTBF) associated with the replacement of carbon engine starter oil face seals on aircraft with ceramic face seals.
  - Continue advanced materials partnerships in structural materials: demonstrate low cost processing of ceramic composites for jet engines; demonstrate a versatile process for lowering the cost of hot isostatic pressing of superalloy powders.
  - Broaden scope of advanced materials partnerships to include: the development of advanced thermoelectric materials and devices; the application of biomaterials and biomimetric materials to military concerns; and novel application of nano-structured materials.
  - Demonstrate production of titanium components using laser sintering techniques.
  - Demonstrate production of cast aluminum-beryllium components.
  - Demonstrate secondary processing and joining of ultra lightweight panels.
- Materials and Device Manufacturing. ($19.1M)
  - Demonstrate the capability to produce ceramic components with complex geometry and dimensional tolerances and mechanical properties comparable to mass manufactured advanced ceramics using the Jet Printer technology (3-D printing).
  - Develop a new solid freeform build method for ceramic components based on layer-by-layer photolithography utilizing either large area liquid crystal display, or a light emitting diode display technology for electronic/programmable photomasks.
  - Test reconfigurable machines and tools in shop floor beta test sites.
  - Demonstrate fabrication process for microintegrated smart materials.
  - Demonstrate roll-to-roll processing of laminate multichip modules.
- Advanced Materials and Processing. ($24.2M)
  - Determine the economic viability of Templated Grain Growth (TGG), a process by which solid phase epitaxy of crystallographical oriented seeds on near net shaped pollycrystalline components is used for growth of single crystal-like oxides.
  - Determine the performance characteristics of low cost, damage tolerant fibrous monolith components in engine environments.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-01

- Demonstrate control of plasma sprayed metal-matrix processing and extend process control models to physical vapor deposition of metal coated fibers.
- Complete development of a plasma/ion etch numerical simulation.
- Demonstrate predictive capability of high-pressure, low-order, chemical vapor deposition models and demonstrate feedback control to a desired wafer state.
- Demonstrate intelligent processing of large area chemical vapor deposition (CVD) diamond with a production cost of $1.00 per karat.
- Grow single crystal boules for three inch diameter silicon carbide semiconductor wafers by scaling up the reactor and developing larger seed crystals.
- Demonstrate vibration reduction by a factor of ten in machine tools via specially designed sensor/actuator elements to enhance machining tolerances.

• Vapor Phase Processing. ($14.5M)
- Demonstrate a 5X cost reduction in production of thin film photovoltaic modules.
- Demonstrate high yield multilayer coating of complex shape turbine engine components.
- Demonstrate high temperature superconducting technology with greater than fifteen square inch format and greater than eighty percent yield.

• Environmental Sciences. ($9.9M)
- Demonstrate a supercritical water oxidation pilot plant for the destruction of shipboard excess hazardous materials.
- Demonstrate novel recycling/reclamation techniques for disposal of scrap polymer matrix composites.
- Develop advanced erosion/corrosion resistant thin film coatings for military applications.

• Magnetic Materials and Devices. ($5.9M)
- Demonstrate large area deposition of GMR materials.
- Fully characterize spin transistor and other spin polarized transport devices for use in ultra-high density memory applications.
- Demonstrate prototype/giant magneto-resistive (GMR) magnetic memory cell and spin transistor memory cell using magnetic multilayers.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-01

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	148.6	122.7	146.3
Appropriated	149.3	126.0	N/A
Current Budget	140.9	120.4	110.2

(U) **Change Summary Explanation**:

FY 1995 Decrease to fund TRP earmark.
FY 1996 Decrease reflects inflation savings ($-1.5 million) and termination of polymer matrix composite effort ($-4.1 million).
FY 1997 Decrease reflects transfer of chemical and biological defense program to OSD and termination of polymer matrix composite effort.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: March 1996
APPROPRIATION/BUDGET ACTIVITY: RDT&E, Defensewide; BA 2 Applied Research	R-1 ITEM NOMENCLATURE: Materials and Electronics Technology, PE 0602712E

COST *(In Millions)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Microelectronic Device Technologies MPT-02	87,440	57,597	71,824	87,157	95,396	99,222	98,881	Continuing	Continuing

(U) **Mission Description**: This element develops advanced electronic and optoelectronic devices, semiconductor process tools and methodologies, materials for optoelectronics and infrared devices. Areas of emphasis include high performance analog-to-digital converters (ADCs), military optical processors, novel optoelectronic devices and modules, artificial neural network technology, low power electronics, non-volatile memory, digital radar processor components, electromagnetic interference (EMI) semiconductor susceptibility, high temperature electronic devices, and high power electronics. This microelectronics development project creates the technology base for advanced electronic and optoelectronic components to meet DoD needs. In this project, the feasibility of promising research results are developed to the point where their military utility can be determined.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Demonstrated and validated heterojunction bipolar transistor design and fabrication technologies in pilot production facilities for component applications in high speed systems. ($19.3M)
- Developed and demonstrated electronic neural network technologies for high performance, high bandwidth signal and image processing applications. ($8.1M)
- Established architecture, software requirements, and core supporting technologies to enable improved image processing, based on advanced neural networks. ($3.0M)
- Developed 3.3V Silicon-on-insulator technologies for low power electronics. ($12.1M)
- Developed Cadmium-Zinc-Telluride seeded growth technologies to produce large diameter, single crystal, controllable orientation materials and demonstrated large format, staring infrared focal plane arrays using seeded growth materials. ($12.9M)
- Initiated consortium to develop technologies for nanolithography, nanoelectronics, and high speed supercomputer visualization. ($9.0M)
- Developed and demonstrated fabrication of critical components for affordable optoelectronic modules, including vertical cavity surface emitting lasers (VCSEL), high bandwidth graded index plastic optical fiber, low error rate digital busses, and demonstrated component integration and insertion in electronic systems. ($23.0M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-02

(U) FY 1996 Program:

- Develop heterojunction bipolar transistor process, device, and design technologies for application in high-speed analog-to-digital converters, digital-to-analog converters, multiplexers, and demultiplexers. ($9.2M)
- Deliver the first-generation of hardware and software for advanced image processing. ($6.4M)
- Complete development of advanced electronic neural network technologies for target tracking and recognition applications. ($6.5M)
- Develop critical materials, processes, and device technologies for .25µm silicon-on-insulator semiconductor fabrication. ($8.5M)
- Develop optoelectronics technologies to enable cost-effective fabrication and integration of module subassemblies for digital optoelectronic processors, bus and backplanes, and serial/parallel input/outputs. ($26.4M)
- Initiate efforts to design radio frequency photonic components for transmission of millimeter waves and microwaves. ($.6M)

(U) FY 1997 Program:

- Develop integrated CAD tool set for high speed (>1GHz) designs and initiate demonstration of high speed analog-to-digital prototype. ($7.0M)
- Complete hardware/software integration for advanced vision system, and demonstrate image recognition. ($8.5M)
- Demonstrate functionality and operation of high performance optoelectronic, digital processor prototype and develop advanced optoelectronic fabrication approaches and subassembly component technologies. ($20.7M)
- Develop component and fabrication technologies for radio frequency photonic components for application in millimeter wave and microwave transmission. ($7.7M)
- Improve silicon-on-insulator materials and device fabrication methodologies to enable a low power, radiation tolerant, 0.18µm technology generation. ($10.4M)
- Initiate efforts to develop advanced digital-based RADAR processor components based on high speed semiconductor technologies, such as heterojunction bipolar transistors. ($6.0M)
- Establish a methodology for investigating the susceptibility of new semiconductor technologies to electromagnetic interference and electrostatic discharges. ($3.1M)
- Initiate efforts to develop non-volatile memories. ($3.7M)
- Demonstrate operation of semiconductor switches, based on silicon-carbide materials, capable of sustained handling of high electric power. ($4.7M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: March 1996
APPROPRIATION/BUDGET ACTIVITY: RDT&E, Defensewide; BA 2 Applied Research	R-1 ITEM NOMENCLATURE: Materials and Electronics Technology, PE 0602712E, Project MPT-02

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	92.9	62.2	81.9
Appropriated	84.0	60.7	N/A
Current Budget	87.4	57.6	71.8

(U) **Change Summary Explanation**:

FY 1995 Increase funds a Congressional TRP earmark in nanoelectronics.
FY 1996 Decrease due to Bosnia reprogramming action ($1.2 million) and below threshold reprogramming ($1.9 million).
FY 1997 Decrease due to a reprioritization of DoD resources.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Cryogenic Electronics MPT-06	16,819	28,942	9,835	11,240	10,183	12,546	15,000	Continuing	Continuing

(U) **Mission Description**: Thin film electromagnetic materials have reached a stage of development where specific applications can be identified in electronic devices and circuitry for military systems. Films are deposited and patterned to form electromagnetic components in ways that are similar to, and compatible with the processes of semiconductor processing. Such electromagnetic components, as well as complementary metal oxide semiconductors (CMOS), work best at lower temperatures, so that cryogenic packaging generally will be required for highest performance. Thin-film high temperature superconducting (HTS) components packaged with cryogenic devices are being applied to radars, electronic warfare suites, and communications systems to enhance performance by more than an order of magnitude while reducing size and power requirements. Particular demonstrations include an upgraded ship-defense radar (SPQ-9B) with 100X greater detectability of missiles in littoral clutter, and a switchable filterbank with 24 individually tuned high-performance filters to suppress Electronic Warfare (EW) saturation in radar warning receivers. Highly dependable and inexpensive cryocoolers are being developed for these applications, and new efforts will explore techniques to improve cryogenic performance in applications ranging from communications to computing.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- High Temperature Superconductors/Analog and Digital Applications ($13.4M): The most promising HTS applications have been identified: (1) Cryo-radar for ship defense, (2) Switchable filterbanks for radar warning receivers, and (3) digital circuitry for signal processing. The following accomplishments have been achieved:
  - Demonstrated noise floor performance of a HTS stabilized oscillator (STALO) fully packaged with a cryocooler.
  - Demonstrated the selectivity performance of a channelized filterbank for a cryo-radar receiver.
  - Within the Consortium for Superconducting Electronics (CSE), a 9-pole high-power filter was developed for communications purposes.
  - Contracts were initiated with principal cryocooler manufacturers to demonstrate 3-year dependability and 5X price reductions of their standard products.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-06

- High Temperature Superconductors/Cryoelectronic Modules ($3.4M): The integration of HTS devices and interconnects with cooled conventional electronics has produced substantial performance benefits. These subsystem modules can be inserted into larger computers and processors to provide 2X overall system improvement.
  - A thin-film interconnect/multi-chip module has shown 2X improvement at low temperature.
  - A processor module, when packaged in a cryocooler, has shown a performance improvement of 50% at -50C.
  - Initiated effort to demonstrate a multi-Gb/s communications switch system (Tektronix), utilizing HTS, MCM and cryogenic CMOS as enabling technologies.

(U) FY 1996 Program:

- High Temperature Superconductors/Analog and Digital Applications ($4.0M): In this final year of the HTS Program, components will be evaluated for integration within military avionics.
  - Continue integration of 24-element filterbank with refrigerator for application to F-15 aircraft.
  - Undertake evaluation of cryo-radar with HTS STALO, at NRL Chesapeake Bay Facility.
  - Complete funding for Consortium for Superconducting Electronics.
  - Continue development of a high-performance 8x8 asynchronous transfer mode (ATM) cryogenic switch in a wide area network.
- Cryogenics Technologies. ($15.1M)
  - Undertake development of small/inexpensive reliable cryocoolers.
  - Develop electronic devices and components optimized for cooled operation.
  - Initiate applications demonstrations, with integrated cryocoolers and temperature-optimized components.
  - Militarize several small low cost cryocoolers for insertion into radar and Electronic Countermeasures (ECM) systems.
  - Develop miniaturized cryopackage for High Stability Cryo-STALO for Airborne Radars.
- High Temperature Superconductors/Analog and Digital Applications. ($9.8M)
  - Develop simultaneously switchable and tunable HTS filters, preserving low insertion loss and high quality factors.
  - Examine applicability of 2nd generation HTS filters to interference reduction in communications sets, particularly SINCGARS radio.
  - Develop Broadband Waveform Generator incorporating HTS Josephson Junction array for Advanced Radar Applications.
  - Develop small HTS magnets for energy storage and mine countermeasures.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-06

(U) FY 1997 Program:

- Cryogenics Technologies. ($9.8M)
  - Continue fabrication of cryo-radar, using HTS components and upgraded conventional components such as driver and active array, for final demonstration in FY98 with a simulated Naval scenario.
  - Upgrade HTS switchable filter sets with tunable filters, for simpler construction and operation into aircraft Electronic Countermeasures (ECM) suites.
  - Evaluate results of cryo-crossbar switch and ATM efforts. Determine most appropriate insertion for digital systems employing HTS devices as well as cryo-CMOS.
  - Determine most important communications application of cryo-components.

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	17.7	12.0	12.2
Appropriated	17.8	30.9	N/A
Current Budget	16.8	28.9	9.8

(U) **Change Summary Explanation**:

FY 1995 Reduction to finance TRP earmark.
FY 1996-97 Decreases reflect minor repricing.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Materials & Electronics Technology, PE 0602712E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Military Medical/Trauma Care Technology MPT-07	14,632	28,270	26,672	31,214	37,686	44,407	48,500	Continuing	Continuing

(U) **Mission Description:** The objective of this project is to revolutionize far-forward battlefield trauma care. The project recognizes that planned downsizing of U.S. forces creates new pressures to ensure force readiness, skill mix, and effective joint doctrine at a time when battlefield casualties carry both strategic importance and tactical relevance. A review of combat casualty care has shown: (1) that 90% of combat deaths occur in the zone of close combat prior to medical or surgical intervention; (2) that fratricide continues at casualty rates as high as 20%-30%; (3) that casualty location is a continuing battlefield problem; and (4) that less than 5% of U.S. Army active-duty physicians have treated combat casualties.

(U) The DARPA Defense Healthcare Technologies program has two major segments: (1) Advanced Biomedical Technology and (2) Healthcare Information Infrastructure. The first segment exploits DARPA's unique leadership role in the electronics and information sciences areas to project advanced medical and surgical care into the far-forward battlefield area to effect early, successful, clinical intervention. In one thrust, this program will develop lightweight personnel status monitors (PSMs) permitting remote non-invasive clinical diagnosis, casualty localization, and friend-foe identification. The PSM, which would be worn by all soldiers as part of their combat uniforms, is further augmented with low power, secure, wireless communications and Global Positioning Satellite system (GPS). The PSM would monitor the soldiers' clinical vital signs continuously, but would remain otherwise passive unless either queried by an operational commander or the soldiers' vital signs departed from established clinical norms.

(U) In a second thrust, this program will develop the technology base for early far-forward medical/surgical intervention. The goal is to preserve critical organ system function, prevent exsanguination, reverse systemic shock, and prevent hypoxia by use of automatically controlled devices to provide immediate mechanical or pharmacologic therapy. Once pharmacologic or early surgical stabilization has been achieved, the patient will be evacuated in a critical care life support for trauma and transport pod (LSTAT) which will function like an autonomous single-patient hospital intensive care unit.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Materials & Electronics Technology, PE 0602712E, Project MPT-07

(U) In a third thrust, workers will develop and exploit advanced simulation technology to improve the training of battlefield health care providers and to ensure skill currency. The objectives of this effort are to provide for the virtual representation of human structure and function; ensure near-seamless transition from training to clinical practice; and to permit simulation of combat-casualty medical care within the framework of operational battlefield requirements. The broader impact of whole-body virtual simulation on undergraduate and continuing medical education programs will allow military medical students to integrate traditionally separate academic disciplines and dramatically reduce the need for human cadavers. Virtual prototyping is provided of medical environments such as mobile operating rooms, critical care life support for trauma and transport pod (LSTAT) and instruments/equipment inserted by casualty care simulations. New technologies for presenting information and training scenarios will be developed using human interface technologies.

(U) A fourth thrust will develop high-fidelity diagnostic imaging, particularly in biomedical applications of Computed Tomography (CT), ultrasound, infrared (IR), and conventional X-rays. For example the particular problem that is encountered in ultrasound imaging is that the medium (i.e., human) tissue is inhomogeneous and scatters the signal, which blurs the image. The process for developing high-resolution imaging will build upon the emerging technology of adaptive acoustics, the displays of which are intuitive and easily interpreted by the combat medic and physician.

(U) In the other segment of the Defense Healthcare Technologies program, the development of an advanced healthcare information infrastructure supports the entire trauma care technology base. Medical information must flow seamlessly and transparently on all levels of patient care. For this to occur, a platform-independent medical record system, such as the battlefield electronic patient record (BEPR), will ensure immediate continuity, distribution, and accessibility of medical information from the forward battlefield to the rear echelon support in U.S. based medical centers. This information will be achieved in multimedia heterogeneous databases of laboratory studies, radiologic and pathologic images, inpatient medical records, and be available over a world wide telecommunication system for real-time interactive collaboration among physicians. In addition, the infrastructure will provide a clinical associate system which is an intelligent system that assists physicians, nurses, corpsmen and paramedics in assessing and treating patients.

(U) This work does not duplicate any efforts of the Military Services or the National Institutes of Health. A Memorandum of Agreement exists between the Army Medical Department and DARPA.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Materials & Electronics Technology, PE 0602712E, Project MPT-07

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Advanced Biomedical Technology ($5.5M): The basic research portion of this effort is in PE 0601101E, Project MS-01.
  - Demonstrated working prototype of Personnel Status Monitor (PSM) with geolocation, communication and vital signs (pulse rate, Electrocardiogram (EKG), respiratory rate), prototype medic hand held unit with locator and reception of vital signs.
  - Demonstrated 2nd generation telesurgical system with two robotic arms, 5 degrees of freedom (DOF), mounted in an armored vehicle (M577).
  - Demonstrated completed shell of life support for trauma and transport (LSTAT) with full integration of NATO stretcher and functional demonstration of respirator, vital signs monitor.
  - Demonstrated 2nd generation (tissue deformation) of simulated combat wound (to replace animal wounding for combat medic training) with gunshot wound to the mid thigh derived from the National Library of Medicine (NLM) Visible Human dataset with surgical instruments to remove bone fragments and shrapnel from the wound.
  - Demonstrated insertion of dismounted warrior into the virtual battlefield using 2nd generation I-Port device ("Tread-Port") and JACK figure (the simulated human dismounted combatant) over a Defense Information System (DIS) compatible network. The wounded soldier avatar shows effects of wounding (rapid breathing, blue discoloration) which returns to normal with proper first aid.
- Healthcare Information Infrastructure. ($9.1M)
  - Developed software architecture for a user-oriented associate system that captures ambulatory care data directly from physicians during patient visits.
  - Developed associate system that provides trauma guidelines directly to medics during emergencies and combat care scenarios.
  - Demonstrated shared electronic, graphic based planning and collaboration tools for multiple users in a distributed health and human services associate system.

(U) FY 1996 Program:

- Advanced Biomedical Technology. ($16.5M)
  - Integrate into the Personnel Status Monitor (PSM) closed-loop control algorithms for fluid infusion and mechanical ventilation support. Complete specialty version (Ranger Overwatch PSM) with temperature, heart rate and motion sensors for insertion into Ranger training exercises.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Materials & Electronics Technology, PE 0602712E, Project MPT-07

- Complete first prototype limb trauma simulator and deliver to U.S. Army Special Operations Command (USASOC) Medical Training facility.
- Incorporate trauma mimicry into the trauma extremity simulator.
- Complete 7 degrees of freedom (DOF) end-effectors and wireless communication packages for Remote Telepresence Surgery System.
- Complete and deliver first prototype of life support for trauma and transport (LSTAT) (one for each service).

• Healthcare Information Infrastructure. ($6.2M)
- Integrate models of combat doctrine and knowledge-based decision support tools (combat casualty protocols and guidelines) in support of combat medics and physicians.
- Demonstrate hands-free capture of patient data under battlefield conditions.
- Demonstrate integration of battlefield electronic patient record with peacetime care systems.

• 3-D Ultrasound Technologies. ($2.5M)
- Develop battlefield/trauma ultrasonic imaging technology for 3D interpretation of body structures.
- Examine Synthetic Aperature Radar processing techniques to determine those features which are pertinent to the ultrasonic imaging problem; begin testing algorithms which could mitigate the contribution of multiple scattering sites to image degradation.

• Biological Warfare Defense. ($3.0M)
- Begin characterization of immune response to sonicate inoculation in bacterial, viral and bio-engineered threat species.
- Develop ionization source and curved-field reflection for tiny mass spectrometer.
- Preliminary exploration of approaches to transfect and characterize the induced genetic changes in stem cells or their derivative lineages for the purpose of potential defense against biological weapons.

(U) FY 1997 Program:

• Advanced Biomedical Technology. ($14.6M)
- Incorporate miniaturized Global Positioning Satellite (GPS) chip into Personnel Status Monitors (PSMs) for the transmission of vital sign and situational awareness data to battalion level command.
- Incorporate full haptic interface (sense of touch) into limb trauma simulator and phase one of organ system into surgical simulation.
- Develop interchangeable surgical tools for remote telepresence, robotically controlled, and coupled in force-feedback loops for enhanced operational dexterity.
- Extend the development of portable digital X-ray to 20 x 20 cm detector array, for field use.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Materials & Electronics Technology, PE 0602712E, Project MPT-07

- Healthcare Information Infrastructure. ($7.5M)
  - Extend combat casualty protocol based care to disease (non-battle) injuries.
  - Demonstrate integration of combat casualty care data with Joint Task Force reference architecture for Global Combat Control System (GCCS) compliant data services.
- 3-D Ultrasound Technologies. ($4.6M)
  - Continue to develop and implement the techniques of adaptive acoustics to ultrasonic imaging, utilizing 2-D sensor arrays and image processing.

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	14.9	29.1	29.3
Appropriated	14.6	24.3	N/A
Current Budget	14.6	28.3	26.7

(U) **Change Summary Explanation**:

FY 1996 Increase reflects Chemical Biological Warfare Medical Program ($3.0 million), minor repricing ($1.1 million), and inflation savings cited on reprogramming actions ($-.1 million).

FY 1997 Decrease reflects minor program repricing.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Experimental Evaluation of Major Innovative Technologies	**581,818**	**582,616**	**635,553**	**685,876**	**680,496**	**747,899**	**769,757**	**Continuing**	**Continuing**
Command & Control Information Systems EE-21	53,934	46,394	47,765	57,300	62,100	104,169	124,034	Continuing	Continuing
Advanced Space Technology EE-27	8,381	3,000	0	0	0	0	0	0	N/A
Guidance Technology Program EE-34	8,912	11,876	10,499	15,000	16,600	11,112	28,000	Continuing	Continuing
Advanced Ship-Sensor Systems EE-36	31,975	23,494	18,844	21,330	62,096	84,478	89,696	Continuing	Continuing
Advanced Simulation EE-37	73,948	61,884	48,419	42,279	44,698	62,948	65,353	Continuing	Continuing
Unmanned Undersea Vehicle Systems EE-39	33,901	15,518	0	0	0	0	0	0	N/A
Critical Mobile Targets Systems EE-40	109,437	110,921	0	0	0	0	0	0	N/A
Air Defense Initiative EE-41	34,109	27,563	21,777	18,579	20,479	20,690	20,690	Continuing	Continuing
Global Grid Communications EE-45	43,236	42,945	42,024	48,392	33,916	32,750	39,549	Continuing	Continuing
Defense Simulation Internet EE-46	14,591	25,911	39,675	3,000	0	0	0	0	N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Fast Ship/Future Ship EE-47	0	0	16,382	65,000	40,000	13,000	8,000	0	N/A
Combat Hybrid Power System EE-48	0	0	15,000	20,000	20,000	10,000	10,000	Continuing	Continuing
Tier III Minus UAV EE-49	*	23,655	14,749	5,000	0	0	0	0	N/A
Battlefield Awareness EE-50	0	0	69,201	93,466	82,755	99,400	106,787	Continuing	Continuing
Small Unit Operations EE-51	0	18,486	52,666	51,580	39,897	27,912	0	0	N/A
Information Integration Systems EE-53	0	0	67,914	90,400	100,300	60,000	50,000	Continuing	Continuing
Classified Programs EE-CLS	169,394	170,969	170,638	154,550	157,655	221,440	227,648	Continuing	Continuing

*FY95 was appropriated to the Defense Airborne Reconnaissance Program in PE 0305154D.

(U) **Mission Description**: This program element is budgeted in the Advanced Technology Development Budget Activity because its purpose is to demonstrate and evaluate advanced research and development concepts. Funding for fourteen projects are requested in FY 1997 within this program element such as the Air Defense Initiative, Command and Control Information Systems, Advanced Simulation, and Global Grid Communications projects. A number of advanced concept technology demonstrations are funded within these activities and several projects have dual-use applications. A discussion of the most significant projects follows.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E

(U) The Air Defense Initiative (ADI) is examining innovative technologies to counter the airborne threat posed by cruise missiles and manned aircraft. Technologies under evaluation include sensor upgrades and data integration and identification improvements. Advanced infrared measurement and high resolution digital imagery systems are also under development, and a simulation and modelling effort is included to test and demonstrate ADI concepts.

(U) Advanced Simulation efforts will provide a distributed, scalable seamless warfighting environment at the weapon level of detail that will ultimately provide a massive synthetic theater of war capable of supporting such requirements as readiness training, doctrine refinement, requirements analysis, battle management simulation, and contingency planning. Communications and data infrastructures, range instrumentation and computer image generation are just a few of the developmental activities funded in the Advanced Simulation program.

(U) The Global Grid Communication project will develop and demonstrate advanced communications technologies needed for defense and intelligence operations for the 21st century. The ultimate goal is deployment of a gigabit network that will be interoperable with commercial, optical and secure wireless networks.

(U) The Advanced Ship-Sensor Systems project develops and demonstrates advancements in a wide range of technologies used in ship sensor, signal processing mechanical systems and advanced maritime platforms to significantly enhance the capabilities of naval and maritime forces.

(U) This program element also includes efforts in advanced Guidance/Targeting technologies, and the Defense Simulation Internet.

(U) The Tier III Minus UAV program (EE-49) is developing and demonstrating a Low Observable High Altitude Endurance Unmanned Air Vehicle System capable of providing the war fighter with the near real time ability to assess battlefield situations synaptically.

(U) Five new projects have been initiated: 1) Fast Ship/Future Ship (EE-47) is developing new ship designs capable of high speeds and naval battle support; 2) Combat Hybrid Power Systems (EE-48) efforts will develop a hybrid electric power system to power combat vehicles; 3) Small Unit Operations (EE-51) will explore and develop the technologies to expand the capability of squad-level warfighters to control large battlespaces, remotely engage enemy targets, and operate across a wide spectrum of conflict situations; 4) Information Integration Systems (EE-53) will

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E

develop enhanced means to evaluate and compress the massive data streams provided by modern surveillance systems so that the information required by battlefield combatants is available on a near real time basis; and 5) Battlefield Awareness (EE-50) is addressing imagery data collection processing capabilities by developing a Semi-Automated Imagery Processing advanced concept technology demonstration to enhance battlefield situational awareness, as well as developing sensor assets and evaluating the exploitation of sensor products.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: March 1996
APPROPRIATION/BUDGET ACTIVITY: RDT&E, Defensewide; BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE: Experimental Evaluation of Major Innovative Technologies, PE 0603226E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Command Control Information Systems EE-21	53,934	46,394	47,765	57,300	62,100	104,169	124,034	Continuing	Continuing

(U) **Mission Description**: Recent military operations, e.g., Desert Storm and Haiti, demonstrated that current theater command, control, communications, intelligence/information systems, planning and rehearsal systems, and non-lethal weapons capabilities lack the ability to support effective operations in diverse new arenas and scenarios ranging from desert heavy battle to urban areas with large civilian populations. Current capabilities do not provide critical interoperable wide-area communications and fail to provide real-time situational awareness, decentralized battle planning, rehearsal and execution capability, and flexible interfaces. The goals of the programs in this project, described individually below, are to enhance information processing, dissemination and presentation capabilities by inclusion of information concerning enemy and friendly forces, providing a joint situational awareness picture and improved planning and execution support capability (through the Joint Forces Air Component Commander (JFACC) Initiatives, Battlefield Awareness and Data Dissemination (BADD) Advanced Concept Technology Demonstration (ACTD) and the Advanced Joint Planning (AJP) ACTD); and providing multi-media information interfaces to on-the-move users (through the Speakeasy program). Integration of planning and battlefield awareness programs is an important element of our strategy for achieving battlefield dominance through information systems. The Command and Control for Joint Early Entry (CCJEE) and the Commercial Communication Technology Testbed (C2T2) programs are being refocused into integration and evaluation tasks to support the JFACC program and the AJP ACTD and to link them to BADD.

(U) Elements of the LAC/MAINS programs applicable to Joint Air Campaign Planning and prosecution of time-critical targets (described under EE-40) has been refocused to support the Joint Forces Air Component Commander (JFACC) Program. The JFACC program seeks to develop key advanced technologies that will markedly improve the commander's ability to conduct air operations effectively and efficiently. Key technologies include: centrally managed, multi-stage, concurrent plan generation; intelligent strike resource scheduling techniques; dynamic resource reallocation algorithms; adaptive cueing tools; automated information routers; and information tailoring tools. These technologies will be applied to requirements that include: continuous mission planning processes which quickly anticipate and react to emerging targets; full integration of intelligence and operational activities to support strike operations and prioritized target nomination; empowerment of cross functional product teams to quickly respond to changes; and proper battlefield knowledge to support activities and decisions at multiple echelons.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-21

(U) Emerging technologies in Command and Control planning promise significant enhancements in operational readiness, planning and crisis response. The Advanced Joint Planning (AJP) ACTD seeks to integrate and install selected advanced planning tools, in a distributed collaborative environment at US Atlantic Command (USACOM), to evaluate the potential for enhancing Battle Staff Command and Control capabilities. Based on the evaluation results of this selected subset of planning tools, a full set of tools will be integrated into the USACOM Battle Staff Planning System. This "leave behind" system will form the model for upgrades to other CINC's Planning Systems.

(U) The objective of the Battlefield Awareness and Data Dissemination (BADD) Advanced Concept Technology Demonstration (ACTD) is to deliver a synchronized, consistent description of the battlefield, allowing the field commander to design or adapt his command and control system to mission needs for effective application of force. The description of the battlefield provided to the warfighters under this ACTD will be tailored to their mission needs by intelligent selection of information to be broadcast and intelligent request (pull) and filtering at the warfighter workstation so that needed information is available. The ACTD focusses on the dissemination of the data required to present a consistent description of the battlefield and will provide the required infrastructure, information management capabilities, user applications and interfaces to intelligently manipulate data products, apply commercial direct broadcast technology for wide-band, low-cost dissemination of multi-media information and provide tactical internet services for two-way communications. A set of applications will be included in the ACTD to support the warfighter in the extraction of information about threats and other important aspects of the battlefield from nearby and remote real-time sensor data streams, intelligence sources and stored data bases. BADD will be evaluated through participation in exercises, demonstrations and ongoing pilot services.

(U) Speakeasy will demonstrate a software-programmable communication system in a tactical environment. Speakeasy, which operates over the 2 Mhz to 2 Ghz band, provides the capability to implement wireless communicaitons concepts to meet Service requirements. Speakeasy is an open architecture-based, software-programmable communications terminal supporting simultaneous operation on a minimum of six radio frequency waveforms (four programmable channels in addition to ones for the global positioning system and cellular). The program is transitioning to the Services in FY 1997.

(U) Integration of planning and battlefield awareness programs is an important element of our strategy for achieving battlefield dominance through information systems. The Command and Control for Joint Early Entry (CCJEE) and the Commercial Communication Technology Testbed (C2T2) programs are being refocused into integration and evaluation tasks to support the JFACC program and the AJP ACTD and to link them to other programs such as BADD.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-21

(U) Under the Joint Casting program, current casting process emissions are being characterized and new casting practices developed to reduce the emissions of foundries in anticipation of Clean Air Act standards for volatile organic compounds and other pollutants.

(U) **Program Accomplishments and Plans:**

(U) FY 1995 Accomplishments:

- CCJEE: Initiated evaluation of Army Deep Operations Center System (ADOCS) for adaptation to an Early Entry battle management system capability; effort started to investigate/design inference engine to provide monitors/triggers events for real-time situational awareness; began development of rehearsal capability through extension of simulation technology. ($1.5M)
- Speakeasy: Completed Phase I interoperability and programmability demonstration with GFE Single-Channel Ground and Airborne Radio System (SINCGARS), Have Quick and HF radios; demonstrated advanced bridging functionality between SINCGARS, Have Quick and police in Joint Warrior Interoperability Demonstration (JWID) '95; awarded Phase II contract. ($9.0M)
- Commercial Communications Technology Testbed (C2T2): Conducted squad, platoon and company level demonstrations of leveraged advanced civilian personal communications and computation technology for dismounted soldiers and vehicles, in military operational training/test environment. Linked situation awareness and intelligence to ground soldiers. ($8.6M)
- SECURES initiated development of a deployable urban environment gunshot detection sensor grid. ($1.8M)
- Dual applications/Operations-Other-Than-War (OOTW): Initiated development of covert tags using a family of small modular low power devices to perform functions of sensing, navigation, and communications; and unobtrusive antennas. Developed and demonstrated quick reaction body armor inserts to replace current Ranger vest; conducted materials assessment demonstration for advanced materials for helmets and covert armor; and initiated development of improved torso armor. Initiated development of less than lethal systems. Initiated analysis of air vehicle communications. Initiated system developments to demonstrate connectivity of multi-user private wireless connectivity to databases and decision support tools and for telemedicine demonstration. Initiated design concept for small mobile sensor. Initiated handbook of perimeter security technologies. ($17.5M)
- Advance Joint Planning (AJP) ACTD: Initiated the development of metrics for and integration, demonstration and installation of selected advanced technology planning tools in a distributed collaborative environment

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-21

with the United States Atlantic Command (USACOM) operational sponsorship to support readiness, planning and crisis response. ($4.9M)

- Joint Casting: Focus to date has been on metals and processes used in the automotive industry and not the high-end alloys used primarily in aerospace (funding provided via other PEs). Beginning in mid-FY 1995 the program began to investigate aerospace alloy casting emissions and other DoD relevant foundry operations. ($10.6M)

(U) FY 1996 Program:

- Speakeasy: Continue the development of advanced technologies for the Speakeasy multiband, multimode modules in preparation for first incremental capability demonstration in December 1996. This capability will be utilized in the Task Force XXI Advanced Warfighting Experiment (AWE) by the 1st Brigade 4th Infantry Division. ($12.6M)
- Advanced Joint Planning (AJP) ACTD: Evaluate metrics of installed planning tools. Based on the results from previously installed planning tools, integrate and demonstrate additional planning tools which will result in a completed integration of planning tools at United States Atlantic Command (USACOM). Expand the functionality of systems to crisis response; and evaluate the installed planning tools and associated metrics under operational conditions for future design incorporation. Develop integration and test environment for evaluation of operational effectiveness of commander's planning tools. ($17.0M)
- Battlefield Awareness and Data Dissemination (BADD) ACTD: Demonstrate an initial capability that includes Warfighter Associate functions with local databases, filtering on tags, profiles, requests, static/dynamic visualization and video interaction; and Information Dissemination Manager functions with repository, object tagging, and video/data broadcast. BADD is also funded in part under EE-40 (Critical Mobile Targets-Warbreaker) in FY 1996 and will be consolidated into EE-53 (Information Integration Systems) in FY 1997. ($8.5M)
- Strategic Packaging for Single Chip Modules and MCMs will develop revolutionary new low cost packaging technology for high pin-count chips and multi-chip modules. ($2.4M)
- Demonstration of interoperability between off-island military resources and island civil forces in response to a hurricane threat. ($5.9M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-21

(U) FY 1997 Program:

- Speakeasy: Continue development of hardware and software technology for the Speakeasy demonstration radio and conduct Model Year 2 demonstration. Transition program to the Services to complete development in FY 1998 and FY 1999. ($5.3M)
- Advanced Joint Planning ACTD: Based on prior year evaluation, complete the design, accomplish modifications and installation of a "leave behind" operational system, which can then be replicated for other CINCs. ($15.7M)
- Joint Forces Air Component Commander (JFACC) Initiative: Final demonstration of target systems analysis. Initial demonstration of continuous planning process which will enable "just in time" tasking. Initial demonstration of air campaign assessment process which relates intelligence information to air campaign goals. Demonstration of improved reconnaissance planner which addresses more platforms and interfaces with the continuous planning process. Initial demonstration of air campaign plan visualization capability to support JFACC decisionmaking. ($26.8M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	55.0	61.4	38.6
Appropriated	45.3	55.0	N/A
Current Budget	53.9	46.4	47.8

(U) **Change Summary Explanation**:

FY 1995 Increase reflects initiation of Advanced Joint Planning ACTD.

FY 1996 Decrease reflects net effect of: Funding of the Battlefield Awareness and Data Dissemination (BADD) ACTD and transfer of the Military Operations in a Built-up Area (MOBA) to Project EE-51. ($7.8 million); rescission of small satellite program ($-1.0 million); inflation savings on DD-1415 reprogramming actions ($-1.9 million); and program repricing ($+2.1 million).

FY 1997 Increase reflects net effect of: Funding of the Battlefield Awareness and Data Dissemination (BADD) ACTD and transfer of the Military Operations in a Built-up Area (MOBA) to Project EE-51.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-21

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan	Milestones
Jun 96	Deliver initial BADD capability to 2nd AD.
Jul 96	Expand the AJP-ACTD functionality of systems to crisis response.
Sep 96	Evaluate the installed AJP-ACTD planning tools and associated metrics under operational conditions.
Dec 96	Demonstrate Speakeasy Model Year 1 initial capability in support of Task Force XXI Advanced Warfighting Experiment (AWE).
Jan 97	Demonstrate initial objectives-based targeting module for JFACC.
Feb 97	Support Task Force XXI Advanced Warfighting Experiment.
Aug 97	Demonstrate Speakeasy Model Year 2 open system architecture.
Sep 97	Complete the design, accomplish modifications and installation of "leave behind" AJP-ACTD operational systems.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Guidance Technology EE-34	8,912	11,876	10,499	15,000	16,600	11,112	28,000	Continuing	Continuing

(U) **Mission Description:** Fire-and-forget stand-off weapons need precise targeting information if critical fixed and mobile targets are to be eliminated effectively and with minimal collateral damage and minimum cost-per-kill. This requires that: (1) military surveillance and targeting systems geo-locate targets accurately in the same coordinate system (i.e. WGS-84) in which the weapon system navigates; (2) the surveillance, targeting and weapon systems have precision navigation and guidance systems on-board; and (3) navigation and target location systems cooperate day/night and in adverse weather. In addition, future systems designed to accomplish precision strike missions must be significantly more affordable. The achievement of these characteristics in an integrated system is the goal of this program. The advanced navigation and guidance technologies being developed in support of this goal are called the Global Positioning System (GPS) Guidance Package (GGP). GGP technologies are applicable for both new or retrofit guidance/navigation packages for aircraft and weapons.

(U) GGP tightly integrates a miniature GPS receiver and an all solid state, low cost, navigation-grade, interferometric fiber optic gyroscope (IFOG) based miniature inertial measurement unit (MIMU) with an advanced navigation computer into a low cost ($15,000), precision navigation system. GGP Phase I addressed the technology issues involved in: (1) miniaturizing inertial grade inertial measurement units (IMUs) into a compact, manufacturable configuration; and (2) developing a multi-channel-on-chip, high dynamics receiver. A Memorandum of Agreement (MOA) has been signed and implemented to demonstrate a Phase 1 unit on an Army Fire Support Team Vehicle (FIST-V). Successful demonstrations were conducted at Redstone Arsenal in June 1995 using a M981 FIST-V. GGP Phase 2 requirements place more stressing demands on performance of MIMU components and call for further reductions in size, power and weight. An MOA has been signed with the Navy designating GGP Phase 2 as the Navy's Advanced Integrated Navigation and Control Package. Two MOAs are in process. One is with the Program Executive Officer, Tactical Missiles, Army Missile Command. The second with the Program Manager, Bradley FIST-V, Army Tank and Automotive Command.

(U) **Program Accomplishments and Plans**

(U) FY 1995 Accomplishments:

- Delivered Phase 1 Guidance Package (GGP) brassboards for testing GGP. ($.5M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-34

- Completed test and demonstration of GGP on the Army FIST-V. ($.4M)
- Initiated Government laboratory and field evaluations of GGP Phase 1 brassboards. ($.6M)
- Initiated two competing GGP Phase 2 designs. ($2.0M)
- MSAG - designed and developed a 100-tile test array which will demonstrate an active conformal array for full duplex operation in a satellite link for testing on a Medium Altitude UAV. ($5.4M)

(U) FY 1996 Program:

- Continue Global Positioning System (GPS) Guidance Package (GGP) Phase 2 designs. ($11.0M)
- Conduct demonstration of Phase I GGP units on a Navy testbed aircraft. ($.9M)

(U) FY 1997 Program:

- Complete GPS GGP Phase 2 designs and begin fabrication of two competitive GGP units. ($10.5M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	10.1	26.2	29.7
Appropriated	9.1	12.1	N/A
Current Budget	8.9	11.9	10.5

(U) **Change Summary Explanation**:

FY 1995 Reflects minor repricing.
FY 1996-97 Reflects minor repricing in FY 1996 ($-.2 million) and elimination of the Sharpshooter precision strike development and demonstration project.

(U) **Other Program Funding Summary Cost**: N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-34

(U) **Schedule Profile**:

Plan	Milestones
Aug 96	Complete Government evaluation of Phase 1 units on a Navy aircraft.
Jun 97	Conduct GGP Phase 2 critical design review.

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Advanced Ship-Sensor Systems EE-36	31,975*	23,494	18,844	21,330	62,096	84,478	89,696	Continuing	Continuing

*In FY 1997, this project consolidates programs under PE 0603226E, Project EE-39 and PE 0603569E, Project AS-01.

Project EE-39	(33,901)	(8,897)
Project AS-01	(31,400)	(31,910)

(U) **Mission Description:** The objectives of this project are to develop and demonstrate advanced systems concepts and to pursue critical enabling technologies for maritime systems that will counter the threat created by the world-wide spread of increasingly sophisticated military technology. The evolving threat of quiet diesel submarines, the proliferation of sophisticated submarine and weapons capabilities, and the growing stockpile of underwater mines available to third world countries necessitates the development of far-term solutions for increasing ship affordability and enhancing our operating capabilities in the littoral. This project will provide advanced technologies to enhance the capabilities of naval forces to more effectively operate "...forward from the sea" in a broader range of tactical environments.

(U) The Advanced Ship-Sensor Systems Program includes Sonar Technology, Advanced Ship Mechanical Systems, and Advanced Maritime Platforms. In the Sonar Technology area, applications of advanced object detection, classification, and localization technologies using High Performance Computing (HPC) are demonstrated. Active and passive sonar techniques are applied, using advanced sources and sonar systems built from distributed elements or concentrated arrays. Advanced signal processing techniques to integrate real-time information and background intelligence into the operational situation is also included. These applications will result in enhanced Anti-Submarine Warfare (ASW) capability against diesel-electric submarines operating in shallow water. In the Advanced Ship Mechanical Systems area, technologies such as precision active structural controls, actuator and sensor systems and high speed digital signal processing are being developed. These technologies will result in reduced ship acoustic signatures, high performance/high reliability propulsion systems, a safer/more survivable ship, and increase ship system affordability. Advanced Maritime Platforms focuses on the technologies for large offshore structures, innovative ships and ship systems to provide the multi-mission, sustained presence capability required for joint operations associated with future regional conflicts.

(U) Commencing in FY 1997, this project will incorporate programs formerly under the Submarine Technologies Project (AS-01) and the Unmanned Undersea Vehicle (UUV) Project (EE-39). These projects are reported separately in their

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-36

respective Budget Item Justification Sheets for FY 1995 and FY 1996. Innovative technologies to significantly enhance submarine stealth and survivability including hydrodynamic control, advanced materials/structures, and structural acoustics efforts to reduce ship observables will continue to be developed and demonstrated. They form the basis for efforts addressing affordability through improvements in structural acoustic design capabilities, innovative machinery mounting systems and high reliability propulsion systems. The Supercavitation Technology Program will continue to address the physics of launching and propelling underwater bodies at velocities approaching the speed of sound in water. Unmanned Undersea Vehicle (UUV) technologies under development include a Synthetic Aperture Sonar (SAS) system to increase underwater search rates; advanced acoustic communications that will enable tether-free control of minehunting UUVs; a micro-miniaturized tactical weather station able to scavenge energy from the environment and provide needed meteorological/oceanographic measurements; small autonomous taskable machines for mine neutralization in, and near, the surf zone; and a clandestine surveillance system employing autonomous taskable machines.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Continued development and testing of autonomous multistatic active technologies for shallow water environment tactical sonars. ($4.1M)
- Conducted proof-of-concept tests and provided initial assessment of multistatic shallow water active surveillance. Conducted at-sea ASW technology demonstration in Korean Strait. ($3.8M)
- Accelerated development of autonomous diesel electric submarine detection and classification technologies and conducted laboratory demonstration of candidate systems. ($3.0M)
- Restructured scene management to accommodate autonomous detection effort. Demonstrated high frequency tactical active sonar processing and scene generation capability. ($1.7M)
- Completed development and testing of polymer transducer array modules. ($.7M)
- Continued development of impulsive sources by extending capability to very shallow water and environmental adaptability. ($1.7M)
- Initiated development of technology for a small craft that would be reconfigurable for different missions in support of operations in shallow, littoral waters. ($1.8M)
- Initiated preliminary design for a Mobile Offshore Base. Completed preliminary design of the Landing Ship/Causeway (LSQ/C) concept. Prepared preliminary and sub- and full-scale demonstrations of critical technologies. ($13.7M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-36

- Developed capability to assess alternatives for collection and relocation of coastal and harbor sediments (deep ocean relocation) using advanced interactive modeling/simulation. ($1.5M)

(U) FY 1996 Program:

- Complete development of multistatic active adaptive processing and impulsive sources for shallow water tactical sonars. Complete assessment of potential of multistatic active adaptive technology. Conduct fleet Anti-Submarine Warfare (ASW) demonstration of multistatic active tactical processor and other components. ($8.2M)
- Accelerate autonomous ASW detection effort and extend to multi-targets and broader application to fleet systems. Deploy and evaluate initial (one class) autonomous submarine detection and classification package. ($3.6M)
- Exploit available wide-swath, mine locating Synthetic Aperture Sonar (SAS) sea test data, investigate potential improvements which can be realized by incorporating state-of-the-art motion compensation. ($.5M)
- Explore stand-alone, low-frequency, acoustic source options for insonification of high interest, littoral waters to support high probability ASW search of these areas. ($.4M)
- Evaluate enhanced torpedo attack phase performance to be realized from fiber obtic weapon link to launch platform and inititate planning for feasibility demonstration. ($.4M)
- The following activities were funded by Congressional additions to the FY 1996 President's Budget:
  - Complete design and assemble off-board autonomous detection and classificaion package in preparation for demonstration in sea test. ($2.9M)
  - Conduct simulation and modeling of information exchange and potential improvements among fleet platforms, ASW sensors and other sources to establish a basis for pursuing performance technical enhancement opportunities. ($2.0M)
- Develop a design and system architecture for an autonomous deployable sensor package suitable for long term monitoring of disposal sites for the Deep Ocean Relocation Program. ($2.5M)
- Develop design concepts for improved survivability of naval combatants-damage control without direct crew participation. Develop and demonstrate proof-of-concept sensors/sensor network to remotely monitor, assess, and control casualty conditions throughout the ship. ($2.0M)
- Perform studies to develop technology options for future surface ships. This work will lead to activities performed under Project EE-47 starting in FY 1997. ($1.0M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-36

(U) FY 1997 Program:

- Conduct final at-sea ASW demonstration of environmentally adaptive shallow water active sonar technology in conjunction with single/few platform scene generation capability. ($1.2M)
- Experimentally validate the physics of supercavitation and feasibility of a hypervelocity gun. ($.8M)
- Complete development of autonomous ASW multi-target detection technology. ($.8M)
- Fabricate and test a prototype active transmission vibration isolation mount. ($4.0M)
- Conduct at-sea demonstration of drag reduction, maneuvering control, and signature control using Electromagnetic Turbulence Control (EMTC) on a large scale vehicle. ($2.0M)
- Develop the Automated Multi-static Active/Passive Receiver System (AMARS) which is the receiver made for the littoral surveillance system. ($4.5M)
- Design and initiate the fabrication of a prototype acoustic mine detection and classification system for a large (10sqnm/hr) area coverage rate. ($3.0M)
- Develop a measurement system and perform ocean tests to measure long range active coherence extending into shallow water. ($2.5M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	34.3	16.5	33.5
Appropriated	32.7	25.4	N/A
Current Budget	32.0	23.5	18.8

(U) **Change Summary Explanation**:

FY 1995 Reflects minor program repricings.

FY 1996 Reflects minor program repricing, Bosnia reprogramming ($-.8 million), transfer to the Small Unit Operations ($-.8 million), and minor repricing ($-.3 million).

FY 1997 This project incorporates programs formerly under the Submarine Technologies Project (AS-01) and the Unmanned Undersea Vehicle Project (EE-39). It also reflects the transfer of the Mechanical Technology Initiative program to the Advanced Land Systems Technology Project TT-04 in PE 0602702E, and the transfer of Sensor Systems to the Small Unit Operations Project EE-51 in PE 0603226E.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-36

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan	Milestones
4QFY96	Complete development of multistatic active adaptive processing for shallow water tactical sonars.
4QFY96	Complete Large-Scale Demonstration of advanced Aeroderivative Engine active control technology.
4QFY96	Conduct at-sea demonstration of an active tactical acoustic system for shallow water environment.
4QFY96	Complete preliminary design for a Mobile Offshore Base (MOB) concept.
4QFY96	Demonstrate simulation and visualization techniques of dredged material isolation process.
4QFY96	Complete design concept for survivable naval combatant.
1QFY97	Complete active transmission vibration isolation mount prototype test.
2QFY97	Demonstrate Electromagnetic Turbulence Control (EMTC) at-sea on a full scale marine vehicle for acoustic quieting, drag reduction, and signature control.
3QFY97	Demonstrate sensor/sensor network proof-of-concept for remote monitoring, assessment, and control of shipboard casualties.
4QFY97	Demonstrate prototype active transmission vibration isolation mount.

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E

COST *(In Millions)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Advanced Simulation EE-37	73,948	61,884	48,419	42,279	44,698	62,948	65,353	Continuing	Continuing

(U) **Mission Description:** The strategic environment in which the United States operates places emphasis on joint crisis response and requires coordinated joint and service training programs to ensure readiness. Resources will continue to shrink, requiring the Department to search for the most cost effective means to address varied threats across the full spectrum of military activity. To support the National Military Strategy, the Advanced Distributed Simulation program is developing advanced simulation technologies to effectively and efficiently construct a seamless synthetic battlespace that will enable fundamental changes in how mainline defense functions are accomplished. The ultimate goal is to create warfighting simulation technologies, capable of representing Joint Forces up to a theater of war, and supporting the following functions: Joint/Service readiness training; Joint/Service doctrine refinement and development; requirements analysis; design and prototyping; and contingency planning. Specific technology efforts being undertaken as part of this project include simulation system design, incorporating the DOD High Level Architecture (HLA); synthetic environment development, synthetic forces development, and, networking and information transfer. As technologies mature, they will be integrated, tested and demonstrated in exercises of increasing size, complexity and utility. These technologies will transition to service and joint simulations, e.g. JSIMS, WARSIM, etc. through tightly coupled transition programs.

(U) The Synthetic Environment Program concentrates on the creation of synthetic environments for simulation including representation of static and dynamic terrain, weather and environmental phenomena, and diurnal variations. The Synthetic Forces Program creates a scaleable, computer-generated military force that is representative and behaviorally accurate with explicit simulation of the C3I systems and the capability of resolving battle outcomes at the weapon system level of detail. The Networking and Information Transfer Technology Development Program investigates and develops the communication, networking and information transfer technologies necessary to take full advantage of capabilities offered by the next generation communication technology. These technologies facilitate efficient and cost effective utilization of evolving network infrastructure while supporting the requirement to represent 100,000 entities interoperating over the network, in either perceptible-real-time or faster-than real-time.

(U) The Synthetic Theater of War (STOW) program is an integral element of the Advanced Distributed Simulation Technology Program, and has been designated an Advanced Concept Technology Demonstration (ACTD) by the Deputy Under Secretary of Defense for Advanced Technology. STOW is developing the HLA compliant simulation system design which

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-37

will enable the integration of simulation technologies to create a seamless synthetic battlespace to support joint training and mission rehearsal.

(U) The Operational Simulation Technology Program develops simulation technology and integrates it with real-world planning and command and control systems. As a result of this program simulation will act as a bridge to real-world battlespace C2 by enhancing the commander's ability to analyze courses of action, evaluate outcomes, and rehearse mission plans.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Demonstrated technology solutions for an advanced network accommodating 5,000 dynamic entities interacting in a coherent manner across distributed local, metropolitan, and wide area networks. Provided technical solutions enabling networking heterogeneous simulations, simulators, and operational equipment. ($5.0M)
- Continued development of an environmental architecture consistent with advanced distributed simulation development; demonstrated prototype environmental representations integrated with semi automated forces; prototyped high fidelity terrain database in an operational scenario; continued development focused on dynamic environmental effects, dynamic terrain representation and weather effects; continued development of synthetic battlefield data bases to support the Synthetic Theater of War (STOW) 1997 exercise. ($8.2M)
- Continued development and demonstrated prototype synthetic forces architecture and created intelligent software C2 entities within that architecture. Developed and demonstrated increasingly more capable Synthetic Forces representing a broad range of combat forces and characterized by more accurate behavioral representation. ($19.9M)
- Continued development of a design architecture capable of supporting a seamless land/sea/air warfighting simulation representing a force of ever increasing complexity, with a goal of supporting a Major Regional Contingency sized exercise in simulation. ($14.1M)
- Initiated development of advanced simulation technologies to provide improved capability to the post STOW-97 objective system. These initiatives included advances in software development techniques, architecture analysis and tools for the ADS programs. ($4.4M)
- Completed development and integrated advanced distributed simulation technologies supporting the optimum mix of training aids, devices, simulations, simulators and field training to intensify conventional training methods for an armored brigade. ($16.2M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-37

- Initiated design of components for an early entry command and control information systems environment capable of situational representations facilitating evaluations of battle management concept. ($1.6M)
- Validated performance of high-fidelity engineering work stations and motion-based simulator by comparing simulations with actual land vehicle tests. This experiment demonstrated technology developed in PE 0602702E, TT-04. ($4.5M)

(U) FY 1996 Program:

- Continue to develop and demonstrate improved network technologies supporting interaction of 10,000 entities within the HLA compliant simulation operating system. Test and integrated NSA developed, ATM based, network security devices. ($3.4M)
- Continue to improve and demonstrate the technology necessary to create a synthetic battlespace to include increased fidelity of terrain and environmental effects (e.g. fog, smoke, haze); continue development of terrain and environmental data bases to support STOW 1997. Initiate efforts to transition to a HLA compliant system. ($6.1M)
- Continue development of synthetic, artificially intelligent, command entities; expand development of synthetic forces to include representations of additional battlespace entities for all services. Continue to improve functionality of existing synthetic forces. Develop and test a set of standard interface specifications capable of accommodating a variety of technical architectures which represent service unique command and control features. Initiate efforts to transition to an object oriented, HLA compliant subsystem architecture. ($23.1M)
- Continue development of simulation operating systems, testing and integration of technologies, and development of the STOW Advanced Concept Technical Demonstration (ACTD) prototype simulation for the STOW-97 ACTD. ($19.9M)
- Continue development of advanced simulation technologies to include higher level behaviors of synthetic forces, faster-than-real-time simulation, and improved efficiencies for generating simulations. ($5.1M)
- Demonstrate the capability to utilize concurrent engineering tools for land vehicle design, link to synthetic battlefield environments, and tie requirements to design through virtual prototypes. ($4.2M)

(U) FY 1997 Program:

- Integrate and test expanded HLA compliant network and information transfer various technologies and network security devices. Demonstrate these technologies for the STOW 1997 ACTD. ($1.5M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-37

- Continue to develop and transition HLA compliant synthetic environment technology. Continue development of environmental technologies capable of supporting an environmentally robust battlespace to include interactive terrain, battlefield obscurants, diurnal effects. Develop technology for simulating the full range of dynamic terrain effects, e.g. cratering, building positions, fighting. Integrate and transition synthetic environment technologies to the systems integrator for STOW 1997 ACTD. Finalize STOW 1997 ACTD Terrain data base. ($5.3M)
- Continue to develop and transition a broad range of synthetic forces representing combat elements; integrate with the DoD HLA a distributed command and control structure portraying in simulation the influence of one command level on the actions of the subordinate synthetic formations. Continue to develop and demonstrate increasingly more sophisticated behaviors representing an extended set of battlespace reactions such as situational awareness, reaction to the environment and tactical planning. Continue to re-architect synthetic forces to an object oriented, HLA compliant design. Integrate synthetic forces technologies into STOW-97 ACTD. ($13.7M)
- Demonstrate and transition a prototype Joint Synthetic Theater of War simulation system supporting a seamless land/sea/air warfighting synthetic environment capable of representing up to 50,000 entities with a high degree of realism, supporting service and joint operational training while retaining the arbitration of battle outcomes at the entity level of detail. The integrated system will be DoD High Level Simulation Architecture Compliant. ($12.3M)
- Continue to develop an integrated simulation environment capable of rapid course-of-action analysis for a single service, using automated, faster-than-real-time (FTRT) battle simulation, with both friendly forces and reactive OPFOR. Integrate this simulation environment with multi-dimensional analysis tools to enable rapid review of courses of action developed as part of mission planning. ($15.6M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	82.7	79.1	44.3
Appropriated	78.7	66.1	N/A
Current Budget	73.9	61.9	48.4

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-37

(U) **Change Summary Explanation**:

FY 1995 Decrease to finance Advanced Joint Planning ACTD in Project EE-21.
FY 1996 Reflects inflation savings ($-.6 million) and reductions to the core simulation technologies development program ($-3.6 million).
FY 1997 Reflects program repricing.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan	Milestones
Sep 96	Demonstrate and assess the capability of concurrent-engineering tools for land vehicles design using engineering work stations, the driving simulator, and the synthetic battlefield.
Sep 96	Demonstrate advanced network technologies to include dynamic multicasting.
Jan 97	Conduct technical Engineering Demonstration #2 of integrated STOW Technologies.
Nov 97	Demonstrate ICW USACOM the STOW-97 ACTD Synthetic Theater of War representing a Joint Task Force through a combination of virtual and constructive simulation with a high degree of realism and with outcomes arbitrated at the entity level of detail, for the purpose of mission rehearsal and training.
Nov 97	Demonstrate a simulation environment capable of supporting rapid course of action analysis for a single service, using automated, faster-than-real-time (FTRT) battle simulation, with integrated multi-dimensional analysis.

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E

COST *(In Millions)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Air Defense Initiative EE-41	34,109	27,563	21,777	18,579	20,479	20,690	20,690	Continuing	Continuing

(U) **Mission Description:** Air Defense Initiative (ADI) programs form a critical part of the Defense Advanced Research Project Agency's (DARPA) program to ensure defense against cruise missiles and manned aircraft. The programs also complement systems being pursued by other program offices to counter theater ballistic missile threats. The rapid evolution and spread of cruise missile systems and technologies require new approaches and technologies to ensure effective and efficient countering of future airbreathing threats to assets in regional theaters.

(U) The Mountain Top Program objective is to provide a cost effective ground-based radar system for evaluation and advancement of concepts and technologies required for future airborne surveillance radars. Through intense data collection campaigns, the Mountain Top Project identifies and quantifies natural and man-made phenomenology that may limit airborne early warning (AEW) system performance. Central to this activity is the Radar Surveillance Technology Experimental Radar (RSTER), located at the Pacific Missile Range Facility (PMRF), Kauai, Hawaii. Beginning in FY 1996, the Mountain Top Project segregated the RSTER hardware program segment from the signal processing and analysis effort to form two distinct programs: Mountain Top and Advanced Signal Processing. The RSTER system will continue to serve as the focal point for the Mountain Top Program and will concentrate on joint testing and integration activities to effect a successful infrastructure transition to the Services by FY 1998. The signal processing and analysis work has been re-designated the Advanced Signal Processing Program.

(U) The Advanced Signal Processing Program emphasizes the development and Service transition of Space Time Adaptive Processing (STAP) algorithms for airborne radar surveillance applications. The program objective is the development and testing of candidate advanced radar signal processing algorithms in four primary focus areas: 1) mitigation of terrain scattered interference; 2) target detection processing for STAP beamformers; 3) frequency hop waveforms for target height finding, and 4) advanced radar sensor applications. In support of these objectives, program activities will include data base development, phenomenology studies, supporting experiments, and algorithm trade studies. The Advanced Signal Processing program will continue to expand the STAP community by encouraging DoD, industry, and university participation.

(U) The Maui High Performance Computing Center (MHPCC) will continue to provide a vast computational resource for multiple technology efforts, including advanced algorithm development, signal processing, and signature modeling.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-41

The MHPCC complements both the Mountain Top and Advanced Signal Processing Programs and will continue to host the Common Research Environment for STAP Technologies (CREST) shell for Mountain Top data and will provide storage and retrieval access from remote locations, via the Internet and other designated communication links.

(U) HAVE DUNGEON enhances the capability to provide data integration and identification techniques for aerospace defense. Advanced hardware and software is developed to exploit data provided by intelligence sensors and collateral surveillance systems to provide near-real-time warning, attack assessment, and track history for the engagement of hostile targets.

(U) The Simulation and Modeling Program performs dynamic analyses of new Air Defense technologies and concepts, and the effects of their integration into theater force structure. It emphasizes and illustrates concepts to counter the cruise missile and other airbreathing threats. Additionally, Operator-in-the Loop exercises allow the opportunity for warfighters to test and evaluate advanced technology concepts and operations. The program has established interconnectivity to the Air Force Theater Air Command and Control Simulator Facility (TACCSF) and will investigate the value of similar interconnectivity with like simulation sites such as the National Test Facility (NTF) and the U.S. Army Air Defense Artillery School. Seminar wargames with Air Defense personnel as game participants will further explore and assess advanced technology concepts, warfighting tactics, and doctrine.

(U) The Airborne Infrared Measurement System (AIRMS) program will provide improved scientific understanding of the fundamental limits of infrared technologies and will develop analytical tools, models, design methodologies, and associated signal processing algorithms/architectures. The program employs the existing AIRMS testbed airborne infrared imaging sensor and aircraft to collect high resolution digital imagery of airborne vehicles, background clutter, clouds, and other phenomenology.

(U) The Advanced Target Identification (ID) Program objective is to provide high confidence target identification at long range. The program will enable the Air-Directed Surface-to-Air Missile (ADSAM) concept to exploit the kinematic range of the missiles. The program will modify existing sensors with new target identification modes and develop data fusion and decision logic to exploit the synergism between information provided by multispectral sensors and that from other sources such as electronic support measures (ESM). Techniques under consideration include high range resolution target profiling (both monostatic and bistatic), inverse synthetic aperture radar (ISAR) and SAR imaging, and phase imaging of moving structures within the target.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-41

(U) Crown Royal will investigate designs for a radar technology with the potential to revolutionize employment of radar to enhance aircraft survivability in certain mission areas that are of increasing importance in the post-cold war era.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- The Mountain Top Program successfully integrated the RSTER system at the Makaha Ridge site at PMRF and completed a littoral data collection campaign to support investigations of: STAP processing of clutter discretes; bistatic scattering from the sea; height estimates from sea scattered multipath; low altitude propagation and target detection; range profiling, length estimates from wideband signature data; and doppler signatures from helicopters, propeller, and jet aircraft. Activities also included joint testing efforts with the Navy. The established Mountain Top database continues to be distributed to the user community for development and evaluation of advanced adaptive processing techniques. An Alpha version of an advanced Algorithm Development Tool (ADT) was released. ($12.9M)
- The Maui High Performance Computing Center (MHPCC) initiated host activities for the Mountain Top database and the CREST shell. Computing resources were made available and utilized by the user community and remote access capability was demonstrated at the Adaptive Sensor Array Processing conference. All SP-2 node requirements, including dedicated groupings, were defined and exercised. ($1.5M)
- HAVE DUNGEON completed scenario development and development of supporting technical data, and the basic tracker device has been developed. ($.8M)
- The Simulation and Modeling Program (SMP) completed integration of various high fidelity Air Defense models into a dynamic simulation, the Extended Air Defense Simulation (EADSIM). In addition, the program began initial incorporation of a DARPA War Breaker developed dynamic simulation, JUDY, to the suite of tools under the Simulation and Modeling activity. The development of a fast response time, Graphic User Interface (GUI) shell incorporating the entire suite of simulations, models, and various input databases was initiated. Applications of these capabilities focused on investigations of Service Air Defense architectures, support to various OSD and Service studies and analyses, and OSD sponsored wargame activities. Establishment of interconnectivity to other simulation sites nationwide, such as the Air Force Theater Air Command and Control Simulator Facility, was accomplished via a "trusted interface". ($5.6M)
- The Airborne Infrared Measurement System (AIRMS) program completed ground and airborne sensor acceptance tests and characterization flights. It conducted initial flight tests, and began evaluation of operational

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-41

algorithms for target detection and tracking. It has collected imagery of airbreathing targets, ballistic missiles, and various kinds of clutter. ($13.3M)

(U) FY 1996 Program:

- The Mountain Top Program supports the Navy's Cruise Missile Defense (CMD) Advanced Concept Technology Development (ACTD) Phase I Live Fire Demonstration of Navy Wide Area Defense over-the-horizon detection and tracking with the employment of the RSTER as the surveillance, detection, and cueing component of the demonstration. RSTER data collection at the Pacific Missile Range Facility (PMRF) Kokee site includes near field experiments and phenomenology data collection. Following the Kokee site data collection campaign, RSTER will be re-located to the Makaha Ridge site for the test series addressing bistatic scattering from the ocean, multipath height estimation, low altitude propagation and target detection, range profiling, and doppler signatures from airborne targets of interest. ($5.0M)
- The Advanced Signal Processing program is developing a Beta version of RLSTAP, an advanced algorithm development tool. The program will initiate phenomenological studies, tailor the application of the RSTER data base, and define Measures of Effectiveness for a focused data set to evaluate candidate STAP algorithms. ($6.6M)
- The Simulation and Modeling Program (SMP) integrates various high fidelity Air Defense models into a dynamic simulation, the Extended Air Defense Simulation (EADSIM). In addition, a DARPA War Breaker developed dynamic simulation, JUDY, will be fully integrated into the suite of tools under the Simulation and Modeling activity. The development of a fast response time, Graphic User Interface (GUI) shell incorporating selected simulations, models, and various input databases will be completed. Applications of these capabilities focused on investigations of Service Air Defense architectures, support to various OSD, JCS, and Service studies and analyses, and OSD sponsored wargame activities. Specific Air Defense architecture studies and analyses address airborne surveillance (i.e., Navy E-2) and airborne fire control cases in conjunction with airborne (i.e., fighter) and surface based (i.e., ship and land based) weapons systems. Establishment of interconnectivity to other simulation sites nationwide, such as the National Test Facility (NTF) will be initiated. ($5.9M)
- The Airborne Infrared Measurement System (AIRMS) program completes ground and airborne sensor acceptance tests and characterization flights. It will conduct initial flight tests, and began evaluation of operational algorithms for target detection and tracking. It will collect imagery of airbreathing targets, ballistic missiles, and various kinds of clutter. ($5.1M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-41

- The Crown Royal program develops the conceptual design for integration of an appropriate sensor suite and signal and data processing capabilities, making maximum use of existing assets. ($5.0M)

(U) FY 1997 Program:

- The primary emphasis of the Mountain Top Program will be the Service transition of the RSTER asset. These efforts include Navy UHF radar technology component upgrades, and integration and demonstration activities at the PMRF RSTER Makaha Ridge site. Transition activities will be coordinated with the Navy (PMA-231, ONR, PMRF) and BMDO. ($5.0M)
- The Advanced Signal Processing Program will complete refinement of the focused data set, evaluate candidate STAP algorithms for integration and test. Resultant algorithm recommendations will be documented and forwarded to the appropriate Service program offices (i.e., E-2, E-3). ($9.8M)
- The Simulation and Modeling Program (SMP) will continue Air Defense Service architecture evaluations. Support to OSD, JCS, and Service studies and analyses will continue. Seminar wargame activity will be coordinated with other Cruise Missile Defense studies and analyses such as the JCS (J-8 lead) Joint Area Cruise Missile Defense (JACMD) study. Joint Service participation in the evaluation of Air Defense technologies and architectures will be extended through wider Distributed Interactive Simulation (DIS) interconnectivity to include Operator-in-the-Loop exercises at the National Test Facility, the Air Force Theater Air Command and Control Simulator Facility (TACCSF), and the U.S. Army Air Defense Artillery School. Additionally, the program will directly support planned Cruise Missile Defense and Theater Air Defense ACTD activities with simulation of advanced airborne sensor capabilities before the actual conduct of planned demonstrations. ($7.0M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	34.3	23.5	24.8
Appropriated	34.3	27.6	N/A
Current Budget	34.1	27.6	21.8

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-41

(U) **Change Summary Explanation**:

FY 1995 No change.
FY 1996 No change.
FY 1997 Reduction reflects completion of the AIRMS program.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan	Milestones
Mountain Top Program:	
May 96	RSTER re-located at the Makaha Ridge site, PMRF.
Oct 96	Integrate RSTER at Kokee Site, PMRF.
Jan 97	Complete Overwater AEW Data Collection.
Sep 97	Transition RSTER Asset to Services.
Advanced Signal Processing Program:	
Mar 96	Adaptive Sensor Array Processing (ASAP) Conference.
Dec 96	Complete Establishment of Focused Data Sets.
Jun 97	Complete Candidate Algorithm Test and Evaluation.
Oct 97	Deliver Suite of Sensor Compatible Algorithms.
Simulation and Modeling Program:	
Mar 96	Complete Airborne Surveillance Assessment.
Apr 96	Participate in OSD/Net Assessment Seminar Wargame.
Sep 96	Participate in OSD/Net Assessment Seminar Wargame.
Nov 96	Operator-in-the-Loop DIS Exercise with TACCSF.
Jan 97	Apply M&S Capability to ACTD Planning.
Mar 97	Operator-in-the-Loop DIS Exercise with NTF/Air Defense School.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-41

Airborne Infrared Measurement System Program:
Mar 96 Phenomenology Investigations Complete.
Sep 97 Data Analysis Complete.

Advanced Target ID Program:
Oct 96 Initiate Assessments of ID Signatures.
Apr 97 Complete Initial Assessment of ID Signatures.
Aug 97 Complete Plan for Further Investigations.
Apr 98 Submit Interim Report on ID Signatures.
Sep 98 Complete Sensor Modification Plan.

Crown Royal
Jul 96 Deliver Preliminary Design for Aircraft Sensor Suite.
Aug 96 Complete Identification of Sensor Assets.
Sep 96 Initiate Installation and Integration of Sensor Suite.

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: March 1996
APPROPRIATION/BUDGET ACTIVITY: RDT&E, Defensewide; BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE: Experimental Evaluation of Major Innovative Technologies, PE 0603226E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Global Grid Communications EE-45	43,236	42,945	42,024	48,392	33,916	32,750	39,549	Continuing	Continuing

(U) **Mission Description:** This program develops and demonstrates advanced communications technologies needed for defense and intelligence operations for the 21st century. The program will develop advanced information processing concepts to support a geographically dispersed staff for crisis management. Services for an enhanced information infrastructure to support command and control will be developed and demonstrated to be applicable to advanced, high performance networks. This program will demonstrate that commercial communications resources and technologies can be integrated with advanced optical components developed in this program as well as DoD tactical and satellite technologies developed elsewhere. The key elements are: 1) Applications such as intelligent decision aids, that enable a geographically distributed planning staff to develop and analyze a course of action; 2) Advanced services such as scalable file systems, databases, and distributed computing support that are integrated with high performance computing, and free applications from the necessity to work down to the raw data transport level; 3) Demonstration networks that validate the research and development and enable early application development and technology transition into DoD efforts such as Defense Information System Networks; 4) Develop network controls pertaining to management, and security software technologies to enable sensor-to-shooter applications combining all network media; and 5) Develop advanced optoelectronic network component technology and network architecture for scalable and modular networks. The aggregate network bandwidth will be in the range of terabits per second and the network will handle multi-media service for both digital and analog signals.

(U) **Program Accomplishments and Plans:**

(U) FY 1995 Accomplishments:

- Designed and conducted initial assessments of information services for the defense internet; evaluated prototype software components in a software engineering testbed and during an operational exercise. ($18.6M)
- Utilizing planning and decision developed aids, supported the rapid construction of multiple crisis action plans. ($1.8M)
- Integrated DoD and commercial networks and demonstrate services and network management in support of DoD experimental application with military attributes such as crypto surge capability. ($5.3M)
- Developed optoelectronic components for optical network. ($6.9M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-45

- Modeled multi-wavelength reconfigurable network architecture and initiated cost analyses and tradeoffs. ($5.8M)
- Developed optical network management software and control algorithms. ($4.9M)

(U) FY 1996 Program:

- Demonstrate evolving software development practices and the migration of software applications and information services to higher bandwidth networks in an operational exercise involving multiple JTFs. ($17.0M)
- Demonstrate integration on a CONUS/International scale of all networks and demonstrate end-to-end secure transmission and signaling at gigabit rates. ($5.0M)
- Demonstrate high bandwidth operation of critical multi-wavelength components. ($7.3M)
- Field test local area network application of multi-wavelength analog and digital signal transmission. ($8.7M)
- Continue to develop multi-wavelength network management software and control algorithms. ($4.9M)

(U) FY 1997 Program:

- Identify control and protocol issues for operation of multi-wavelength networks. ($4.2M)
- Demonstrate advance integrated optoelectronic network component operations. ($9.4M)
- Complete multi-wavelength network architecture and control planning; and initiate field-trial network deployment for long-distance and wide area applications. ($14.4M)
- Demonstrate integration with advanced testbeds; large scale planning demonstrations; and deployable JTF C3 (mobile C3, plan rehearsal and refinement during deployment, intelligent interfaces). ($14.0M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	44.0	45.2	44.6
Appropriated	44.7	43.4	N/A
Current Budget	43.2	42.9	42.0

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-45

(U) **Change Summary Explanation**:

FY 1995 Decrease reflect minor program repricing.
FY 1996 Decrease reflects Bosnia reprogramming action ($-.5 million).
FY 1997 Decrease reflects program repricing.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Planned	Milestones
May 96	Demonstrate network combining crypto, commercial communications, and defense secure wireless, satellite.
May 97	Demonstrate integration with advanced optical testbeds. Conduct large scale planning demonstrations.
Jul 97	Complete deployable JTF C3 (mobile C3, plan rehearsal and refinement during deployment, intelligent interfaces).
May 98	Complete cross-country demonstration of optical and advanced network management.

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Defense Simulation Internet (DSI) EE-46	14,591	25,911	39,675	3,000	0	0	0	0	N/A

(U) **Mission Description:** The goal of the Defense Simulation Internet (DSI) program is to research, develop and test at scale (worldwide), a network infrastructure capable of enabling distributed, real-time, multi-media (video, voice, shared data and work spaces) simulation that will seamlessly integrate all simulation, modeling, command and control functions from early design to battle rehearsal en route to the conflict. The DSI meets DoD security requirements by using a commercial-off-the-shelf (COTS) encryption device (INES). The communications needs of the distributed, real-time, multi-media modeling and simulation community cannot be met with any other available technology. Commercial vendors are pursuing some of the required technologies, but development is too slow and unfocused to accommodate the immediacy of the Department of Defense's simulation requirements. The DSI program provides focus for the commercial development of the technologies needed by the simulation community for distributed work environments worldwide. Over 100 nodes currently extend the DSI to each of the Services, most of the Commanders-in-Chief (CINCs), some of our allies and other Government affiliated sites. These locations constitute the network's user sites; they provide valuable feedback on the technologies and methodologies being pursued and critical capability for both ongoing and major modeling and simulation events. A key mission of the DSI is to provide real-time infrastructure for the Synthetic Theater of War (STOW) 97. A major program goal is to transition the DSI into the Defense Information Systems Agency (DISA) Defense Information Systems Network (DISN) by the end of FY 1997. The transition of the DSI into the DISN provides affordability through consolidation of the costs required to operate multiple networks while continuing to support modeling and simulation requirements.

(U) **Program Accomplishments and Plans:**

(U) FY 1995 Accomplishments:

- Provided network operations and user services: an increase of 25% in user sites during FY 1995. Operations included management of the 24 hours per day/7 days per week Network Operations Center (NOC), network security, exercise/event planning and management, and a 24 hours per day/7 days per week Help Desk at the DSI Customer Service Center (CSC). ($8.2M)
- Procured telecommunication circuits; Phase I backbone (4 X T1), CONUS Phase II Backbone (T3 upgrade starting in July), Tail Circuits to user sites. ($3.9M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-46

- Upgraded network: Completed Phase I Cutover, increasing bandwidth capacity from T1 to 4 X T1. Upgraded European and Pacific locations, replacing legacy routers with high-speed commercial-off-the-shelf (COTS) routers. Initiated testing and installation of Asynchronous Mode Transfer (ATM) switches into the DISN Leading Edge Services (LES) ATM/T3 backbone, the first step of DSI infrastructure transition into DISN. Provided automated scheduling services to user control and improved network management and interoperability. ($2.0M)
- Initiated Defense Information Systems Agency (DISA) migration planning process and installed a network management viewport. ($.5M)

(U) FY 1996 Program:

- Provide network operations and user services. It is expected that the DSI will become a virtual network of DISN during the 3Q FY 1996. This will contain an estimated 30% more user sites. Operations will include the 24 hours per day/7 days per week NOC, network security, exercise/event planning and management, and the 24 hours per day/7 days per week CSC Help Desk. ($8.7M)
- Procure telecommunication circuits: International circuits (T1 backbone), CONUS Phase II Backbone (T3) Tail Circuits (T1), upgrade select high use Synthetic Theater of War (STOW) sites to T3 tail circuit 4Q FY96. ($10.2M)
- Upgrade network: Initiate upgrade which provides ATM switches and end-to-end encryption for the wide area network interface to the sites and the edge devices which provide the local area interface with the workstation for STOW 97 (30 Sites). Upgrade to commercial standard desktop VTC. Integrate systems management to provide control of end node workstations. ($5.5M)
- Transition management: Provide programmatic integration management and engineering support through the DARPA/DISA (Advanced Information Technology Systems (AITS)) Joint Program Office (ADJPO) to identify and evaluate advanced technology candidates, offer pilot services, and transition LES technology to DISA. ($1.5M)

(U) FY 1997 Program:

- Provide network operations and user services. As a subnet of DISN, it is expected that by the end of FY 1997 the subnet work will contain an estimated 30% more user sites. Operations include the 24 hours per day/7 days per week NOC, network security, exercise/event planning, management and the 24 hours per day/7 days per week CSC Help Desk. Provide STOW Exercise support. ($11.6M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-46

- Procure telecommunication circuits: International circuits (T3 backbone), CONUS Phase II Backbone (T3) Tail Circuits (T1), upgrade high use STOW sites to high capacity tail circuits. ($13.9M)
- Upgrade network: Complete deployment of service upgrade which provides ATM switches, end-to-end encryption and the edge devices to sites which require this upgraded capability (70 Sites). Automate network management to provide real-time management of high speed high bandwidth requirements. Provide resource reservation at the application level. Complete migration of Defense Simulation Internet (DSI) network operations and maintenance to Defense Information Systems Network (DISN). ($11.7M)
- Transition management: Provide programmatic integration management and engineering support through the DARPA/DISA (Advanced Information Technology Systems (AITS)) Joint Program Office (ADJPO) to identify and evaluate advanced technology candidates, offer pilot services, and transition LES technology to DISA. ($2.5M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	16.6	27.5	37.2
Appropriated	14.1	26.5	N/A
Current Budget	14.6	25.9	39.7

(U) **Change Summary Explanation**:

FY 1995 Increase reflects minor program repricing.
FY 1996 Decrease reflects Bosnia reprogramming source ($.3 million) and minor repricing ($.3 million).
FY 1997 Increase reflects minor program repricing.

(U) **Other Program Funding Summary Cost**: N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-46

(U) **Schedule Profile**:

Plan	Milestones
Apr 96	European Backbone Upgrade backup T1 circuit install.
Apr 96	Pacific Backbone Upgrade increase land line bandwidth.
Jul 96	COTS Premise Router Upgrade.
Jul 96	Add COTS Desktop VTC service.
Jul 96	Cutover to DISN LES ATM/T3 Backbone Upgrade architecture.
Sep 96	Complete Phase II Backbone Cutover (T3/ATM).
Sep 96	DISA Network operations center fully functional.
Sep 96	Fully integrate an automated network and life cycle management.
Sep 96	Deploy ATM switches to select STOW 97 sites.
Dec 96	Deploy ATM switches to sites and end-to-end encryption (FASTLANE) to sites.
Dec 96	Initiate Service Migration to DISA.
Feb 97	Integrate applications and hardware requirements to support STOW 97.
Sep 97	Complete network services transition to DISA.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: March 1996

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 3 Advanced Technology Development

R-1 ITEM NOMENCLATURE
Experimental Evaluation of Major Innovative Technologies,
PE 0603226E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Arsenal Ship/Fast Ship EE-47	0	0	16,382	65,000	40,000	13,000	8,000	0	N/A

(U) **Mission Description**: The objectives of this new project have far-reaching implications for the future of surface ships for the US Navy. DARPA will identify and develop high leverage technologies to support future surface ships with an emphasis on littoral warfare. Application potentials include a broad range of future areas including an arsenal ship and/or SC21 to satisfy ordnance requirements, and fast sealift ships - all in support of future regional conflicts. As a result of studies that DARPA has performed, a number of high leverage areas are being considered including: (1) Command and decision making for joint theater CINC assets so ships can be totally integrated into future amphibious theater forces using, flexible information architecture and very robust data links; and (2) High speeds for future ships in support of regional conflicts. Studies have made it very clear that we should expect significant retrenching from overseas deployments by US forces. This, coupled with the growing unaffordability of maritime pre-postitioned logistics will require that future forces be deployable from CONUS. The large travel distances coupled with the future force plans by the US Marine Corps for seamless deployments overseas suggest major payoffs for achieving speeds in excess of 50 or 60 knots and, in fact speeds of 75 knots or greater show major payoffs. Future applications to something like an arsenal ship could allow early delivery of massive firepower to anywhere in the world. DARPA's plans include an evaluation of the feasibility to achieve dramatic increases in the efficiency of high speed lift that will be required to allow this concept to be employed. We intend to explore a broad speed regime up to 100 knots to determine breakpoints: (a) extensive automation to minimize manning; (b) high degrees of passive survivability; and (c) flexible open architecture for entire weapon systems.

(U) **Program Accomplishments and Plans**:

(U) FY 1997 Program:

- Develop and demonstrate technologies for enhancing the effectiveness of surface ships in littoral warfare, including technologies for passive survivability, manning reductions and high speed. ($16.4M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-47

(U) **Program Change Summary:** *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	0	0	0
Appropriated	0	0	N/A
Current Budget	0	0	16.4

(U) **Change Summary Explanation:**

FY 1997 Realignment of Advanced Ship Studies into new project EE-47.

(U) **Other Program Funding Summary Cost:** N/A

(U) **Schedule Profile:**

Plan	Milestones
Jan 97	Down select critical technologies for arsenal ship/SC21.
Jun 97	Complete initial 100 knot speed feasibility assessment.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E

COST *(In Millions)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Combat Hybrid Power Systems EE-48	0	4,240*	15,000	20,000	20,000	10,000	10,000	0	N/A

*The Integrated Product and Process Development Program (EE-37) is developing concurrent engineering/virtual prototyping technology that will be used in the conceptual design and analysis of the Combat Hybrid Power System.

(U) **Mission Description**: Essential requirements for U.S. Cavalry/Scout ground units are to acquire threat information, locate targets, communicate, reduce signatures, and be more mobile and survivable. Essential requirements for close combat units are simultaneous, sustained offensive mobility, overmatching lethality and survivability against heavy threat firepower. The platforms must be air deployable which dictates weight and volume constraints. The military is developing an array of subsystems to support these missions that include: advanced sensor suites and communication equipment, active suspension and electric propulsion systems, signature management suites, countermeasures, active defense, and electric weapons. These subsystems require either continuous or pulsed electric power and in each case a dedicated electrical power supply has been developed for each subsystem. Integration of multiple power supplies into a vehicle is not feasible due to space constraints, cost, and efficiency.

(U) The objective of this program is to address this issue by developing enabling technology and conducting demonstrations of an integrated hybrid electric power system which provides power and energy management for all of the subsystems throughout the cavalry/scout vehicle and is scaleable to future tank platforms. The hybrid electric power system will consist of an engine/alternator sized for average power demand, energy storage and power averaging components which provide both continuous and pulsed power, distribution network, subsystem control and power conditioning devices. Vehicles will be simulated to evaluate subsystem requirements, topologies, and military utility. The program is closely coordinated with the U.S. Army, Navy, Marine Corps, and the DARPA Electric Vehicle Program (EV-01). The DARPA Electric Vehicle Program is a dual-use program to develop and demonstrate electric and hybrid electric drivetrain technology on commercial and military platforms. An electric drivetrain is one of the elements that would be powered by the Combat Hybrid Power System (EE-48) developed in this program.

(U) Hybrid electric power is an enabling technology for future combat vehicles if electrically powered subsystems are to be implemented. The vehicles will have greatly reduced noise and thermal signatures; and improved mobility, survivability, lethality, and fuel economy. By eliminating rigid connections between components, interior layout can be optimized, significantly reducing volumetric constraints. These advantages will result in deployable, affordable combat vehicles that meet mission requirements.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-48

(U) **Program Accomplishments and Plans**:

(U) FY 1997 Program:

- Establish subsystem requirements, evaluate military utility, and provide modeling support to hybrid electric power system technology development. ($1.5M)
- Complete detail design of hybrid electric power system demonstration. ($1.0M)
- Complete design and conduct proof of concept experiments of engine/alternator, power averaging, power conditioning, and power distribution and controller component options. Downselect for fabrication and demonstration. ($12.5M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	0	0	0
Appropriated	0	0	N/A
Current Budget	0	0	15.0

(U) **Change Summary Explanation**:

FY 1997 Reflects realignment of combat hybrid power system technologies into new project (EE-48).

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan	Milestones
Aug 97	Establish subsystem requirements, evaluate military utility, and support hybrid electric power system technology development using integrated, hybrid electric powered combat vehicle virtual prototypes.

5RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Tier III Minus UAV EE-49	(57,221)*	23,655	14,749	5,000	0	0	0	0	N/A

* FY95 was appropriated to the Defense Airborne Reconnaissance Program, PE 0305154D, Project Name/No. LO-HAE UAV/P527.*

(U) **Mission Description:** The objective of this program is to develop and demonstrate a Low Observable High Altitude Endurance Unmanned Air Vehicle (LO HAE UAV) system, including a ground segment, capable of providing the war fighter with the near real time ability to assess battlefield situations. This system will provide continuous, all weather, day/night, wide area reconnaissance and surveillance in direct support of the Joint Forces Commander. It will consist of aircraft, sensors, communications and interfaces to theater systems in support of tactical warfighters at various levels of command. The LO HAE UAV will provide wide area search (over 15,000 sq nm per mission) with either an Electro-Optical (EO) or Synthetic Aperture Radar (SAR) system at 1m resolution. In addition, it will provide 600 spot images per mission with either sensor at 0.3m resolution. The search and spot modes can be interleaved with attendant reductions in the overall coverage. The system will support a targeting accuracy of at least 20m CEP.

(U) The detection capabilities of the LO HAE UAV will allow the system to operate in high threat environments where manned reconnaissance or other operational assets are not viable options.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Completed all tooling. ($2.0M)
- Completed design and fabrication of Vehicles #1 and #2. ($23.2M)
- Rollout and began integration of Vehicles #1 and #2. ($10.0M)
- Completed system integration and ground testing. ($15.0M)
- Conducted flight test planning and complete flight test readiness review. ($1.0M)
- Designed, developed, and integrated the processing and display system (PDS). ($6.0M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-49

(U) FY 1996 Program:

- Complete system integration and conduct Phase II flight test. ($18.7M)
- Complete integration and provide support to system flight test (PDS). ($5.0M)

(U) FY 1997 Program:

- Complete development of Vehicles #3 and #4. ($14.7M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	N/A	N/A	N/A
Appropriated	N/A	23.7	N/A
Current Budget	N/A	23.7	14.7

(U) **Change Summary Explanation**: N/A

(U) **Other Program Funding Summary Cost**:

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Related RDT&E PE0305154D	56.3	66.0	41.0	18.0	23.0	0	0	0	N/A

(U) **Schedule Profile**:

Plan	Milestones
Mar 96	Complete system ground test.
Mar 96	Complete taxi tests.
Apr 96	Commence Phase II flight tests.
Apr 96	Complete integration and provide support to system flight test (PDS).
Jun 96	Commence fabrication and vehicles #3 and #4.
Sep 96	Complete and test EO and SAR payloads.
Jan 97	Commence limited user demonstrations.
Jan 97	Commence vehicle #2 flight tests.
Mar 97	Conduct static and dynamic observable testing.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Sensor and Exploitation Systems EE-50	*	*	69,201	93,466	82,755	99,400	106,787	Continuing	Continuing

* Programs included in this project were previously funded under Project EE-40.

(U) **Mission Description**: This project represents a refocusing and transition of pertinent elements of the Critical Mobile Targets (WAR BREAKER) project (EE-40) into a concentrated effort to empower the battle commander with comprehensive battlespace awareness. The development efforts described herein embody key sensor demonstrations and the exploitation of sensor products. These efforts, in conjunction with those described in Project EE-53 (Information Integration Systems), seek to develop the systems needed to provide the warrior with situational awareness and battlefield dominance. The strategic goal of this project is to utilize diverse, complete, sensing of the battlefield environment, including sensors which can counter Camouflage, Concealment and Deception (CC&D), and provide near-real-time, semi-automatic, exploitation of wide-area moderate (and high) resolution imagery and provide semi-automated recognition and birth-to-death tracking of high value units and critical moving targets. These goals are being addressed by the Foliage Penetration (FOPEN) sensor program, the Semi Automated Imagery Processing (SAIP) Advanced Concept Technology Demonstration (ACTD), Moving and Stationary Target Acquisition and Recognition (MSTAR), Moving Target Exploitation (MTE), and Automatic Target Recognition (ATR) Applications programs.

(U) The goal of the Foliage Penetration (FOPEN) sensor program is to provide significant enhancement of the military's capability to detect obscured targets hidden under natural and artificial camouflage. Specific goals include validation of FOPEN target detection capability (0.1 FA/sq.km max) with data from the P-3 Ultra-Wideband UHF Synthetic Aperture Radar (SAR) testbed and the DARPA-sponsored Swedish Carabas I VHF SAR tests; and demonstrations of real-time processing of FOPEN high resolution SAR image formation, Radio-Frequency Interference (RFI) suppression and Automatic Target Detection/Classification algorithms. The program will be included in a proposed Counter CC&D program which will combine FOPEN technology with other sensor technologies (e.g., hyperspectral sensors) on an Endurance UAV.

(U) The Semi-Automated Imagery Processing Advanced Concept Technology Demonstration (ACTD) will develop, test and transition to the operational user, automated algorithms and semi-automated tools that enhance our capability to: process SAR and other image types more completely; conduct wide-area search for Ground Order of Battle and Missile Order of Battle targets; perform rapid site-monitoring and site modeling; and produce target reports in

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-50

near real-time (< five minutes). Semi-Automated Imagery Processing (SAIP) will consist of baseline, enhanced, and transition systems. Goals for the baseline system are: automatic target cuing and classification for a limited set of vehicles; object level change detection; force recognition to the company level; and interactive tools including model-based target recognition. Additional goals for the enhanced system are: site modeling and monitoring with EO; addition of SIGINT cuing; and on-the-fly training for algorithms. Goals for the transition system are to add the following to the enhanced system: Enhanced automatic target recognition (30 targets); force recognition to the regiment level; site modeling and monitoring with SAR data; and, rapid target insertion. SAIP is built on, will leverage, and, as appropriate for an Advanced Concept Technology Demonstration, integrate program products that are being refocused and transitioned from the WAR BREAKER Program: Monitor, which is developing template-based automatic target recognition capability; MSTAR, which uses a model-based approach to target recognition in Synthetic Aperture Radar; and Topsight, which is developing programs which provide reasoning about detections, coming from low and medium resolution imagery, terrain, doctrine and other sources of intelligence, to identify detected units.

(U) The goal of the Moving and Stationary Target Acquisition and Recognition (MSTAR) program is to achieve a major advance in SAR Automatic Target Recognition performance through fundamental and innovative technology developments. Specific goals include: Probability of detection = 0.9, False Alarm Rate = 0.001/km2, P{correct classification} = 0.7 - 0.9 with squint, layover, 30 percent obscuration, articulation, modification, variable configurations, camouflage, and deception for a large number of time critical and other ground targets. Other program goals include: significant advances in interactive image exploitation environments and performance; and development of rapid ATR updating methods.

(U The goal of the Moving Target Exploitation program is to automatically detect and classify moving targets using MTI radar in the surveillance mode. Three techniques are being investigated: Discriminate desired targets using high range resolution profiling; Image moving targets via enhanced ISAR image formation; and Classify moving targets using image shape and motion characteristics. Specific applications are targeted for JSTARS, TIER II+ and TIER III- platforms.

(U) The ATR Applications project is a combination of supporting technology-base efforts from WAR BREAKER and seeks to use image compression and processing to reduce HAE UAV data rates to SATCOM-supportable rates, and to develop next generation template based ATR algorithms for systems upgrades.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-50

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- See Project EE-40 for FY 1995 Accomplishments.

(U) FY 1996 Program:

- See Project EE-40 for FY 1996 Program.

(U) FY 1997 Program:

- Complete Foliage Penetration (FOPEN) concept design and the integration of all system design components for a FOPEN Demonstrator radar targeted for a medium or high altitude endurance Unmanned Aerial Vehicle. Complete critical technology demonstration of ultrawideband antenna design, airborne real-time processing interface, radio-frequency interference suppression, and FOPEN automatic target detection/classification. Develop a test and evaluation plan with measurement criteria, validation approach and risk assessment matrix by critical technologies in preparation for start of a Counter CC&D program. ($10.0M)
- Transition of all component projects into the SAIP ACTD will be completed and integration continued to achieve enhanced system objectives in continued collaboration with the Defense Airborne Reconnaissance Office (DARO). The site modeling and monitoring component will be integrated, additional Missile Order of Battle and Ground Order of Battle models and algorithms inserted, and the system ported to a High Performance Computer architecture. Tests will be done on system performance with Tier III- and national imagery and the enhanced SAIP system will be available to the Battlefield Awareness and Data Dissemination ACTD (EE-53) to serve as its imagery processor. A test at an overseas operational unit will be initiated. ($35.0M)
- Demonstrate MSTAR recognition of a 10 target set in the open with limited obscuration. ($16.7M)
- Conduct airborne demonstration of Moving Target Exploitation capability to identify and track moving target in traffic. ($4.5M)
- The ATR Applications project, also in collaboration with DARO, will demonstrate a single-scale architecture in the SAIP program, and a multi-scale architecture will be demonstrated in a laboratory environment. ($3.0M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-50

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	0	0	N/A
Appropriated	0	0	N/A
Current Budget	0	0	69.2

(U) **Change Summary Explanation**: Funding transferred from EE-40.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan Milestones
(See Project EE-40 for prior milestones.)
Nov 96 Demonstrate and test baseline SAIP system with ASARS-II at Edwards AFB.
Nov 96 Demonstrate single-scale capability of data compression and screening in SAIP system and MOBSTR/ASARS-2.
Nov 96 Downselect 2 to 1, or merge approaches of MSTAR module developers to enter phase 2.
Dec 96 Test SAIP with Tier III- imagery.
Jan 97 Port SAIP to High Performance Computer.
Jan 97 JSTARS data collection and system demonstration (MTE).
Jun 97 Test SAIP with national product.
Aug 97 Demonstrate Expose/FOPEN ATD/C Processor (P-3).
Oct 97 Install and test SAIP at operational OCONUS site.
Nov 97 Second major demonstration of MSTAR ATRs: 15 targets with increased EOCs.
JAN 98 Airborne demo of data compression/screening capability on U-2R.
Feb 98 Airborne demo of FOPEN target detection (P-3).
Mar 98 Begin testing of SAIP with Tier II+ imagery.
Apr 98 Provide SAIP code to Army for STARLOS hardware implementation.
Jun 98 Operational demo of MTE system on JSTARS.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-50

Jul 98 Initiate SAIP transition to USACOM.
Sep 98 HAE demonstration (MTE).
Sep 98 Integrate and ground test of FOPEN radar demonstrator.
Nov 98 Final MSTAR ATR demo: 20 targets, full range of EOCs; transition to SAIP.
Sep 99 Complete SAIP transition.

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: March 1996

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 3 Advanced Technology Development

R-1 ITEM NOMENCLATURE
Experimental Evaluation of Major Innovative Technologies,
PE 0603226E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Small Unit Operations EE-51	0	18,486	52,666	51,580	39,897	27,912	0	0	N/A

* Programs included in this project were previously funded under Projects EE-21, EE-36, EE-39 and EE-40. Related FY 1996 work performed in projects ST-11 ($3.5M) and TT-04 ($13.1M).

(U) **Mission Description**: The United States will continue to commit military forces abroad as an essential instrument of foreign policy. With declining resources and a smaller military, the Services must be prepared to quickly project sufficient power to achieve United States objectives more rapidly and effectively than we are currently able. The deployment of our forces will be restricted by lift assets and in-theater infrastructure; and they will operate under more complex rules of engagement. Adversaries who are not very powerful may possess sophisticated technology that will place our forces at risk. These risks are increased if our forces are massed to conduct traditional conventional operations. To fight effectively in the future, the Army and Marine Corps are developing concepts of operation (Army - Force XXI and Marine Corps - Sea Dragon) whose tactical implementation will vary, but with similarities that include lighter, more lethal, more flexible forces that are widely dispersed through out the battlefield. The objective is to enable more capable dispersed units to effectively perform warfighting operations traditionally accomplished with larger massed forces. These forces must be able to quickly control a large battlespace with fewer forces, control the operational tempo, engage enemy targets with remote fire, and operate effectively across the spectrum of conflict and in a variety of environments.

(U) The key to success for these units are a vastly improved and highly integrated comprehensive awareness system, robust communications, and an integrated, scaleable common grid of the battlespace. While there are many technology developments underway that will assist the Services to accomplish their objectives, at the tactical level there are technology gaps that DARPA will help narrow under the Small Unit Operations program. Technology development efforts will focus on a comprehensive awareness capability that provides real-time, essential information for small units and individual warfighters; wireless communication technologies to permit exchange of voice, digital and video data with other systems; geolocation technologies that provide navigation information in built-up, forested and mountain environments; internetted tactical surveillance and targeting sensors to complement information requirements not satisfied by national, theater, and component sensor programs; and automated tasking and control technologies for air and ground systems. As these technologies mature they will be tested and evaluated. Engineering demonstrations with

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-51

combatant participation will be conducted to assess program progress in a realistic environment which provides critical user feedback. After successful tests and evaluation, or further refinement of the technologies, they will be integrated and tested with operational units.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments: N/A

(U) FY 1996 Program:

- Develop upper level system architecture, conduct engineering analysis and evaluate advanced concepts/technologies for SUO applications. ($2.8M)
- Complete communications, data stripping and information understanding analyses in support of comprehensive tactical awareness enhancements. Develop candidate communications network architectures. ($1.5M)
- Upgrade and field demonstrate Sea Dragon Communications and Coordination (SDC2) in preparation for Sea Dragon/Force XXI Exercise in 1997. ($7.0M)
- Initiate development of requisite technologies, including precision clocks, to provide precision geolocation for dismounted combatants in a variety of environments, including wooded, mountainous, urban and within buildings. ($4.4M)
- Develop acoustic array sensors, initiate internetted sensor processing studies, and initiate development of mobility and self-location concept. ($2.8M)

(U) FY 1997 Program:

- Assess advanced concepts and technologies for SUO applications. ($1.0M)
- Conduct system integration and demonstrate SUO technologies at CINC and Warfighter exercises. ($5.0M)
- Complete concept of operations, requirements, and architecture definition for below-brigade soldier situation awareness and tasking system. ($1.0M)
- Initiate technology developments for the comprehensive situation awareness and tasking system, focusing on tactical picture generation, tactical forecast, situation assessment functionality. ($5.8M)
- Continue to develop enabling technology for reactive planning and support asset tasking and control. ($7.2M)
- Initiate technology development for tactical communications capability. ($7.9M)
- Complete SDC2 and participate in Joint Army and Marine Corps Exercise. ($2.4M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-51

- Continue development of requisite technologies to provide precision geolocation. ($6.9M)
- Apply and integrate sensing/surveillance technology into tactical sensing developments. ($7.3M)
- Integrate multiple sensors, concepts, mobility and self-location capabilities. ($8.2M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	0	0	0
Appropriated	0	0	N/A
Current Budget	0	18.5	52.7

(U) **Change Summary Explanation**:

FY 1996-1997: Funding transferred from Command & Control Information Systems Project EE-21, Advanced Ship/Sensor Systems Project EE-36, Unmanned Undersea Vehicle Systems Project EE-39, Critical Mobile Targets Systems Project EE-40, Sensors and Exploitation System Project EE-50, Intelligent Systems and Software Project ST-11, and Advanced Land Systems Project TT-04. Of the transfered funds, $.6 million inflation savings was identified on a reprogramming action.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan	Milestones
Mar 96	Demonstrate Acoustic Sensor.
Aug 96	Complete initial requirements definition for Brigade/Battalion and Combatant Warfighter's Tactical Associate.
Mar 97	Complete performance testing of multiple precision clock units in hybrid packages.
Mar 97	Demonstrate sniper, mortar, mine and thru-wall detection sensors at Force XXI EXFOR AWE. Demonstrate near-term mobility and self-location technology at Force XXI EXFOR AWE. Complete SDC2 program and participate in Sea Dragon/Force XXI exercise.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-51

Jul 97	Support MOUT ACTD with SUO technology.
Dec 97	Demonstrate feasibility of local tactical picture generation module for Battalion/Brigade and Combatant Warfighter's Tactical Associate.
Dec 97	Demonstrate and characterize various breadboard precision geolocation technologies in restricted environments.
Jul 98	Downselect final communications architecture.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E

COST *(In Millions)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Information Integration Systems EE-53	*	*	67,914	90,400	100,300	60,000	50,000	Continuing	Continuing

*Programs included in this project were previously funded under Project EE-21 and EE-40.

(U) **Mission Description:** This project represents a refocussing and transition of pertinent elements of the Critical Mobile Targets (WAR BREAKER) project (EE-40) and Command and Control Information Systems Project (EE-21) into a concentrated effort to empower the battle commander with comprehensive battlespace awareness. The goal of this project is to take diverse inputs, including those planned as outputs from the Sensors and Exploitation Project (EE-50), and perform distributed and dynamic all-source correlation and fusion to produce an integrated, geo-spatially referenced, battlefield data-base and knowledge-base, and through the use of wideband dissemination and integrated sensor management allow multi-site, real-time, collaborative situation assessment and course-of-action evaluations. These goals are being addressed by the Dynamic Multi-User Information Fusion (DMIF) project, the Battlefield Awareness and Data Dissemination (BADD) ACTD and the Airborne Communications Node (ACN) project.

(U) Dynamic Multi-User Information Fusion (DMIF) seeks to develop and evaluate a prototype operational system that amalgamates diverse sensor observations and rectifies disparate fusion products to provide the warfighter with consistent and robust battlefield awareness. The system will maintain birth-to-death tracking of high value targets; use distributed, collaborative, dynamic, and all-source correlation, fusion and situation assessment; exploit terrain limitations, enemy doctrine, and first-principle constraints on military operations to construct a hierarchical representation of all battlefield activity; and define a reference architecture to ensure software reuse and in-field modifiability, full uncertainty accounting, and Global Command and Control System (GCCS) Leading Edge Services (LES) compliance.

(U) The objective of the Battlefield Awareness and Data Dissemination (BADD) Advanced Concept Technology Demonstration (ACTD) is to deliver a synchronized, consistent description of the battlefield, allowing the field commander to design or adapt his command and control system to mission needs for effective application of force. The description of the battlefield provided to the warfighters under this ACTD will be tailored to their mission needs by intelligent selection of information to be broadcast and intelligent request (pull) and filtering at the warfighter workstation so that needed information is available. The ACTD focuses on the dissemination of the data required to present a consistent description of the battlefield and will provide the required infrastructure, information management capabilities, user applications and interfaces to intelligently manipulate data products,

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, EE-53

apply commercial direct broadcast technology for wide-band, low-cost dissemination of multi-media information and provide tactical internet services for two-way communications. A set of applications will be included in the ACTD to support the warfighter in the extraction of information about threats and other important aspects of the battlefield from nearby and remote real-time sensor data streams, intelligence sources and stored data bases. BADD will be evaluated through participation in exercises, demonstrations and ongoing pilot services.

(U) Under the Airborne Communications Node (ACN) program, a communications payload for UAVs will be developed that will provide robust gateway, bridging, routing and multimedia communication services for Joint Task Force (JTF) early entry forces and mobile warfighters deployed beyond fixed tactical communication infrastructures. ACN will support information transport requirements, providing situation awareness, planning and rehearsal and JTF coordination.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:
- See Projects EE-40 and EE-21 for FY 1995 Accomplishments.

(U) FY 1996 Program:
- See Projects EE-40 and EE-21 for FY 1996 Program.

(U) FY 1997 Program:
- In the DMIF program, continue development of reusable terrain generation, agile modeling and text processing modules, and demonstrate a prototype stand alone, multi-source, inference-based fusion system for a limited target set at Roving Sands 97. ($23.2M)
- Battlefield Awareness and Data Dissemination (BADD) ACTD: Participate and be evaluated in Task Force XXI Army Warfighting Experiment. Capabilities and services to be evaluated include: Information Dissemination Manager node at the DARPA/DISA Joint Project Office (ADJPO), Imagery Product List (IPL) at the U.S. Atlantic Command (USACOM), leased GBS commercial satellite, fused red and blue ground-order-of-battle picture, and integrated image, video, signals intelligence, terrain, Global Command and Control System and Maneuver Control System data. ($34.1M)
- ACN: Design a ACN relay payload, develop test and begin demonstrations in a system integration laboratory environment. ($10.6M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, EE-53

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	0	0	0
Appropriated	0	0	N/A
Current Budget	0	0	67.9

((U) **Change Summary Explanation**: Funding transferred from projects EE-40 and EE-21.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan	Milestones
Oct 96	Complete design for Airborne Communications Node (ACN) relay payload.
Feb 97	Support Task Force XXI Advanced Warfighting Experiment.
Jun 97	Demonstrate Dynamic Multi-User Information Fusion (DMIF) capability at JPOC 97.
Sep 97	Conduct a ACN system integration laboratory demonstration.
Jan 98	Begin ACN integration onboard airborne platform.
Jul 98	Conduct DMIF demonstration at the U.S. Atlantic Command (USACOM).
Sep 98	Deliver BADD pilot service to OCONUS.
Sep 99	Transition DMIF capability to EUCOM and U.S. Central Command (CENTCOM).
Sep 00	Complete BADD transition to DISA, GBS Joint Program Office (JPO) and the Services.

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Advanced Electronics Technologies	**383,006**	**393,144**	**332,100**	**329,376**	**340,186**	**284,460**	**265,512**	**Continuing**	**Continuing**
MIMIC MT-02	20,472	0	0	0	0	0	0	0	N/A
IR Focal Plane Array (IRFPA) MT-03	42,979	40,025	23,995	9,000	14,000	0	0	0	N/A
Electronic Module Technology MT-04	112,953	98,888	66,149	93,206	144,790	167,761	198,012	Continuing	Continuing
Tactical Information Systems MT-05	13,978	21,259	19,076	22,784	21,646	23,000	27,500	Continuing	Continuing
Microwave and Analog Front End Technology (MAFET) MT-06	19,475	40,504	47,921	50,871	28,201	7,467	0	0	N/A
Centers of Excellence MT-07	35,381	17,056	14,000	0	0	0	0	0	N/A
Manufacturing Technology Applications MT-08	47,692	66,092	34,051	33,455	25,000	21,951	0	0	N/A
Advanced Lithography MT-10	56,321	47,010	51,404	40,000	40,000	40,000	40,000	Continuing	Continuing

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Computer-aided Acquisition and Logistics Support MT-11	33,755	32,295	20,704	15,000	0	0	0	0	N/A
Microelectromechanical Systems (MEMS) MT-12	0	30,015	54,800	65,060	66,549	24,281	0	0	N/A

(U) **Mission Description**: The Advanced Electronics Technology program element is budgeted in the Advanced Development Budget Activity because it seeks to design and demonstrate state-of-the-art manufacturing and process technologies for the production of various electronics and microelectronic devices, sensor systems, actuators, gear drives that have both commercial and military applications. Introduction of advanced product design capability and flexible, scalable manufacturing techniques will enable the commercial sector to rapidly and cost-effectively satisfy military requirements and enhance the U.S. industrial base.

(U) The IR Focal Plane Array project focuses on the establishment of a manufacturing capability for advanced infrared sensor arrays for major weapons systems. This industrial base will allow the systems to meet specification requirements at approximately 1% of the current cost.

(U) The goal of the Electronic Module Technology project is to allow for the timely insertion and rapid acquisition of state-of-the-art microsensors and actuators, conformal electronics and affordable, high performance application specific electronic module (ASEM), components into major military systems. These systems include automatic target recognition, electronic countermeasures and Signal Intelligence (SIGINT). This project includes Advanced Technology Demonstrations in ASEM and Rapid Prototyping of Application Specific Signal Processor.

(U) Tactical Information Systems project contains two major programs: Head Mounted Displays and the Smart Modules. These programs demonstrate high definition miniature displays to provide visual information to individual combatants and small groups who are remotely located from conventional visual information sources.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E

(U) The Microwave and Analog Front End Technology (MAFET) program is the only DoD effort directed at significantly reducing non-recurring costs for military microwave/millimeter wave sensor systems through improved computer aided design capabilities. It will provide urgently needed improvements in the performance and affordability of microwave and millimeter wave components. The MAFET program addresses the essential foundation for all DoD systems and programs making use of microwave and millimeter wave solid state technology.

(U) The Centers of Excellence program finances demonstration, deployment of and training on advanced manufacturing technologies. The goal of this technology is to reduce unit and life-cycle costs while improving quality.

(U) The goal of the Manufacturing Technology Applications program is to reduce the cost and acquisition leadtime of future military systems by integrating manufacturing process considerations during the product design phase, and by demonstrating high efficiency multi-product prototype factories. This program will also enable manufacturers to economically produce military variants of their commercial products in limited quantities through the introduction of flexible process technologies.

(U) Advanced Lithography technology has enabled the dramatic growth of integrated circuit capability. Advances have led directly to improvements in electronic and computing systems performance in terms of speed, power, weight and reliability.

(U) The mission of the Computer-aided Acquisition and Logistic Support program is the transfer of Electronic Commerce (EC) technologies to small- and medium-size enterprises through a network of regional deployment centers.

(U) The Microelectromechanical Systems (MEMS) project is a broad and cross-disciplinary initiative to develop an enabling technology that merges computation with sensing and actuation to realize new systems for both perceiving and controlling weapons systems, processes and battlefield environments. Using fabrication processes and materials similar to those that are used to make microelectronic devices, MEMS conveys the advantages of miniaturization, multiple components, and integrated microelectronics to the design and construction of integrated electromechanical systems.

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
IR Focal Plane Array MT-03	42,979	40,025	23,995	9,000	14,000	0	0	0	N/A

(U) **Mission Description:** The Infrared Focal Plane Array project addresses the technology necessary to produce affordable, infrared (IR) sensor arrays, essential to major weapon systems. The focal plane array consists of a two dimensional detector array sensitive in a broad spectral range, integrated with unique signal processing to enhance performance and provide more efficient utilization of the information. The critical elements of the technology addressed in this program include the infrared material, detector array fabrication, read-out electronics, cryogenic packaging and testing, and module assembly. Processing and fabrication techniques focus on the production of affordable arrays, at low volume, in the configurations required by weapon systems. Performance enhancements in uncooled infrared and near-infrared sensors are also being addressed to provide an integrated, broadband two dimensional sensor array without the cryogenic package usually associated with infrared sensors. Elimination of the cryogenic package dramatically reduces the cost of the sensor module, and provides a sensor package compatible with a wide range of system applications, including navigation, targeting and manportable systems. The solid state integrated sensor also solves the problem of blooming in the presence of high intensity sources, which is encountered with current low light level visible and near infrared sensors. Arrays will be built in the configuration required for missile seekers; target acquisition and navigational platforms; search and track; and threat warning systems.

(U) **Program Accomplishments and Plans:**

(U) FY 1995 Accomplishments:

- Demonstrated state of the art 240 x 2 and 480 x 4 focal plane arrays built at one hundred times less cost than at the initiation of the program. ($9.7M)
- Integrated dry processing into infrared detector fabrication, and produced 480 x 4 arrays meeting system screening criteria. ($7.0M)
- Developed cluster tool compatible infrared detector processes, and demonstrated 480 x 4 arrays, meeting system field requirements. ($18.3M)
- Produced 128 x 128 infrared focal plane arrays with four times greater sensitivity than current missile seeker requirements. ($5.0M)
- Demonstrated wafer level cold probe of infrared focal plane arrays and integrated capability into fabrication lines. ($3.0M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-03

(U) FY 1996 Program:

- Complete development of standard electronic cells for rapid design and fabrication of infrared read-out circuits. ($9.0M)
- Demonstrate uncooled focal plane arrays hybridized to low noise analog readout circuits. ($5.0M)
- Demonstrate focal plane array fabrication using four inch diameter silicon wafers. ($14.0M)
- Verify computer aided design tool for infrared sensors; including cryogenic packaging. ($12.0M)

(U) FY 1997 Program:

- Demonstrate capability to fabricate 480 x 640 uncooled infrared sensor with one mil pixels. ($5.5M)
- Assess capability to fabricate thin film ferroelectric uncooled infrared sensor. ($5.0M)
- Evaluate imaging performance and anti-blooming of uncooled solid state sensor. ($8.0M)
- Demonstrate low noise amplification in the pixel unit cell. ($5.5M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	44.1	36.7	19.3
Appropriated	43.0	35.8	N/A
Current Budget	43.0	40.0	24.0

(U) **Change Summary Explanation**:

FY 1996 The increase is due to internal reprioritization of programs.
FY 1997 The increase addresses an accelerated effort in uncooled sensors with broad spectral response. Elimination of the cryogenic package represents a major step toward reducing the cost of sensor module and providing sensors compatible with a wide range of systems.

(U) **Other Program Funding Summary Cost**: N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-03

(U) **Schedule Profile**:

Plan	Milestones
Jan 96	Demonstrate process module concept for multipurpose scanning arrays.
Jun 96	Demonstrate equipment with flexibility to produce various infrared focal plane array configurations on the same line.
Sep 96	Demonstrate large-area staring and scanning array for search and track, target acquisition, and missile seeker systems.
Mar 97	Demonstrate gain stage integrated into the pixel unit cell.
Jul 97	Evaluation of high performance uncooled sensor array.
Dec 97	Demonstrate anti-blooming capability of solid state sensor array.
Mar 98	Field evaluation of large area uncooled sensor with less than 0.1 degree thermal sensitivity.
Jun 98	Evaluation of integrated sensor with broad band infrared response.
Dec 98	Demonstrate solid state sensor with improved anti-blooming performance.

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Electronic Module Technology MT-04	112,953	98,888	66,149	93,206	144,790	169,761	198,012	Continuing	Continuing

(U) **Mission Description:** The Electronic Module Technology Project is a broad initiative to substantially decrease the cost and increase the performance of weapon systems through the timely insertion of state-of-the-art electronic modules. Electronic module technology addresses the design and fabrication of various types of digital, analog, and mixed signal modules consisting of electronic, electro-optical and micro-mechanical components. It includes traditional approaches such as printed circuit boards and emerging technologies such as high density Multichip Modules (MCMs).

(U) The project has five major objectives: (1) shorten the overall design, manufacture, test, and insertion cycle for advanced electronic subsystems; (2) advance the state-of-the-art in electronic interconnection and physical packaging technology to allow circuits to operate close to their intrinsic maximum speed with less overhead in terms of volume, weight and cost; (3) provide a robust manufacturing infrastructure for electronic modules; and (4) demonstrate the system level payoff of electronic module technology through advanced technology demonstrators (ATDs).

(U) The project has the following major elements: (1) Application Specific Electronic Modules (ASEM); (2) Multichip Integration (MCI); (3) Rapid Prototyping of Application Specific Signal Processors (RASSP); (4) High Density Microwave Packaging (HDMP); and (5) Electronic System Manufacturing (ESM). ASEM will reduce the non-recurring engineering time and cost for designing and inserting complex electronic modules. MCI will produce order of magnitude reductions in manufacturing cost and accelerate the acceptance and insertion of Multichip Integration technologies. RASSP is a major ARPA/tri-Service initiative which seeks to dramatically reduce the development time and life cycle cost of advanced signal processing capability while ensuring state of the art performance when the processor is fielded, not just when it is first defined. HDMP is developing microwave frequency, thin, lightweight multichip packages for use in applications such as active scanned arrays. It is expected to result in cost reductions of up to 75% compared to present approaches with excellent performance. The ESM program will develop new technologies for the assembly of compact, high-performance, electronic and electro-mechanical systems. The programs leverage related efforts developing component technologies such as semiconductors, displays, MCMs, and Microelectromechanical Systems (MEMS), as well as physical Computer Aided Design (CAD) tools in order to achieve a dramatic reduction in system assembly cost.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-04

(U) **Program Accomplishments and Plans:**

(U) FY 1995 Accomplishments:

- Developed microwave frequency multichip module housings, internal packaging interconnections, array interconnect technology, module assembly and integration and Computer Aided Design (CAD) tools and databases. Perform tests on modules to assess performance; assess projected per unit cost savings. ($5.2M)
- Continued the Application Specific Electronic Modules (ASEM) program with heightened emphasis on mixed signal modules and application demonstrations. Delivered new software tools to streamline the error-free design of Multichip Modules (MCMs). ($23.8M)
- Continued the Multichip Integration (MCI) program with further development of manufacturing equipment, with a focus on the delivery of production modules for military aircraft and other dual-use applications. Demonstrated pilot production line for roll-to-roll fabrication of high density laminate MCMs. ($24.6M)
- Demonstrated improved signal processor design environment incorporating advanced CAD technology, VHDL extensions, and new signal processing algorithms. Completed first Rapid Prototyping of Application Specific Signal Processors (RASSP) system demonstration prototypes and delivered preliminary RASSP benchmark evaluations. Initiated technology transition activities. ($42.8M)
- Demonstrated and multi-site evaluated a sensor cluster for environmental monitoring; multi-device chip run with over twenty different devices (including accelerometers, gyroscopes, flow-sensors, and resonators) fabricated from a single, common, high-volume surface micromachining process of successful operation of a vertical-wall silicon carbide reactor to deposit sensor-grade films over multiple, 100 mm wafers; inserted and tested Microelectromechanical Systems (MEMS) inertial measurement devices in projectile munitions. ($10.2M)
- Demonstrated single-crystal, micromachined tunneling tips with integrated, three-dimensional positioning actuators; prototype multiple-component conformal MEMS sensing and actuating arrays applied to delta-wing model and operated in wind-tunnel tests; demonstrated organization and processing of signals from sensors distributed across control surfaces of underwater vehicles. ($4.4M)
- Disseminated and continued development of a multi-use design library for MEMS devices and systems; dissemination of CAD tools that are coupled to shared fabrication services; completion and continued offering of ninth shared surface micromachining fabrication run reaching over 350 users in the government, industry and academia. ($2.0M)

(U) FY 1996 Program:

- Complete development of required microwave packaging approaches and interconnection circuitry; produce and demonstrate required multichip microwave assemblies. Reassess projected per unit cost savings. ($10.2M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-04

- Demonstrate complete end-to-end Rapid Prototyping of Application Specific Signal Processors (RASSP) design framework with additional demonstration hardware and benchmark evaluations. Develop accelerated framework standards, improved Computer Aided Design (CAD) technology for system testing, and VHDL reuse libraries. Accelerate technology transfer activities. ($34.9M)
- Continue Application Specific Electronic Modules (ASEM) program to reach one month turn-around time and $25K NRE cost for digital Multichip Modules (MCMs). Demonstrate high volume production technology for producing known-good die. ($20.3M)
- Continue Multichip Integration (MCI) program with the delivery of high volume/low cost laminate MCM technology and develop optimized modules and mixed signal applications. ($20.5M)
- Initiate the Electronic Systems Manufacturing (ESM) program by identifying breakthrough technologies to lower system assembly costs, shorten manufacturing cycles, and enable error free transitions to manufacturing. ($3.0M)
- Expand the current effort in Seamless High Off-Chip Connectivity (SHOCC) to include a full scale demonstration of a high-performance microprocessor. This demonstration will segment the integrated circuit design into yield and performance-optimized active elements, fabricate these elements and assemble a fully-functional device on a passive substrate incorporating traces formerly within the chip. Mating of the active die to the substrate will be through a high-density interposer. ($10.0M)

(U) FY 1997 Program:

- Demonstrate final end-to-end RASSP signal processor design environment. Complete technology insertion demonstrations, benchmarking analysis, and technology transition activities. ($7.5M)
- Continue ASEM program and demonstrate new ASEM foundry capability for flexible production of modules with board-level integration. ($19.4M)
- Continue Multichip Integration program to demonstrate order of magnitude reductions in MCM manufacturing costs and MCM technology insertions. Continue insertion of MCM technology into dual-use products such as workstations, engine control and wireless communications. ($25.0M)
- Initiate program to demonstrate new paradigms for integrating electronic, electromechanical, and electro-optical components to enable small, lightweight, battlefield information systems. ($9.5M)
- Continue Electronic Systems Manufacturing (ESM) program to enable DoD systems to efficiently access the commercial, contract manufacturing base for order of magnitude cost savings and enhanced surge capabilities. ($4.8M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-04

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	119.1	134.5	133.8
Appropriated	117.8	136.7	N/A
Current Budget	113.0	98.9	66.2

(U) **Change Summary Explanation**:

FY 1995 Reduction due to below threshold reprogramming to finance a TRP earmark.

FY 1996 Decrease reflects: Creation of a separate MT-12 MEMS Project for greater program visibility ($31.0 Million); Bosnia reprogramming funding source ($3.8 Million); and internal reprioritization of programs ($3.0 Million).

FY 1997 Decrease reflects transfer of MEMS funding to MT-12 ($55.0 Million) and revised DoD priorities ($12.6 Million).

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan	Milestones
Mar 96	Demonstrate improved versions of Rapid Prototyping of Application Specific Signal Processors (RASSP) design environment.
Dec 96	Demonstrate Multichip Modules (MCM) insertions in small diameter missile.
Jun 96	Complete high density microwave packaging (HDMP) final development of housings, interconnect approaches and perform initial module testing.
Jul 96	Demonstrate Application Specific Electronic Modules (ASEM) Technology for assuring known-good die.
Sep 96	Deliver Multichip Integration (MCI) Manufacturing Technology to the dual-use market.
Jun 97	Demonstrate final end-to-end Rapid Prototyping of Application Specific Signal Processors (RASSP) signal processor design.
Sep 97	Demonstrate new mixed signal ASEM foundry capability.
Jun 98	Demonstrate efficient 3-D electromagnetic modeling capability.
Sep 98	Demonstrate MCM substrates with integrated passive components.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E,Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Tactical Information Systems MT-05	13,978	21,259	19,076	22,784	21,646	23,000	27,500	Continuing	Continuing

(U) **Mission Description:** This project is a major DoD effort to develop the technology for displays and portable information systems for use in a variety of military systems. The project has two major programs: Head Mounted Displays (HMDs) and Smart Modules. The Head Mounted Display program is developing world-class miniature displays and integrating these displays into head and helmet mounted configurations for use by pilots, combat vehicle crews and individual warriors as well as for virtual environments and simulation. It is expected that by the year 2000, the military will use more miniature displays for head mounted applications than the cumulative total of all other types portable information systems that combine communication, computation, and navigation for use by individual warriors. The systems will use state-of-the-art displays, multichip modules, microelectromechanical devices, global positioning chips, low power electronics, and efficient energy sources. Emphasis is on augmenting things already carried or worn by warriors (weapons, clothing, binoculars, rangefinders, radios, etc.) with high information content components. Resulting systems will promote enhanced vertical and horizontal battlefield information infrastructures. Significant results will be transitioned to the DARPA Small Unit Operations program in project EE-51.

(U) **Program Accomplishments and Plans:**

(U) FY 1995 Accomplishments:

- Head Mounted Displays - Completed circuit designs for 12 micron pixel and integrated display drivers for 2560 x 2048 pixel display in both liquid crystal and electroluminescent technologies. Completed system tradeoff studies for integrating a 1280 x 1024 pixel electroluminescent display into a medical head mounted display system. Completed ride motion simulation and SIMNET evaluations of the Combat Vehicle Crew head mounted display. ($8.6M)
- Smart Modules - Initiated four projects including: Technology Advanced Mini Eysafe Rangefinder (TAMWER), VuMan TIA, Maintenance and Repair Support System (MARSS), and Voice Map. First phase of TAMER and VuMan TIA have been demonstrated in field exercises with US Army 2nd Armored Division and 1st Marine Expeditionary Forces, respectively. Initial architecture designs for MARSS and Voice Map have been completed. ($5.4M)

(U) FY 1996 Program:

- Head Mounted Displays - Emphasis will be on completing all on-going miniature display efforts and initiating feasibility demonstrations for miniature diffraction grating displays and Microelectromechanical Systems (MEMS) based displays. ($10.3M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-05

- Smart Modules - Emphasis will be on demonstration of four systems for use by individuals remotely located from conventional information sources. Initiate developments to demonstrate individual worn direction finding and video capture capability. ($11.0M)

(U) FY 1997 Program:

- Head Mounted Displays - Demonstrate feasibility of diffraction grating and MEMS based miniature displays. ($8.0M)
- Smart Modules - Provide increased functionality in a pager sized device operating on commercially available batteries. These devices will be built using Shape Deposition Manufacturing processes to demonstrate rapid cost effective prototyping. Demonstrate integrated electronic information capability integrated into soldier clothing. ($11.1M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	14.7	20.2	17.7
Appropriated Budget	15.5	19.6	N/A
Current Budget	14.0	21.3	19.1

(U) **Change Summary Explanation**:

FY 1996 Increase reflects minor repricing for head mounted displays.
FY 1997 Increase reflects inflation savings ($-.2 million) and minor repricing ($+1.9 million).

(U) **Other Program Funding Summary Cost**: N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-05

(U) **Schedule Profile**:

Plan	Milestones
Jul 96	Complete low voltage electroluminescent (EL) project.
Nov 96	2560 x 2048 pixel displays demonstrated.
Jan 97	Integrated CCD, memory, wireless interface in Technology Advanced Mini Eysafe Rangefinder (TAMER).
Feb 98	Demonstrate low power display.
Mar 98	Demonstrate air combat air controller modules.

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Microwave and Analog Front End Technology MT-06	19,475	40,504	47,921	50,871	28,201	7,467	0	0	N/A

(U) **Mission Description:** Microwave and millimeter wave technology for DoD electronic weapon systems is at a critical crossroads. Great progress was been made under the microwave and millimeter wave integrated circuit (MIMIC) program in terms of maturing the gallium arsenide industrial community. The DoD is now far ahead of the commercial world in microwave and millimeter wave technology in terms of performance characteristics. However, in many cases, radio frequency (RF) sub-system costs are still a major impediment to fielding DoD weapon systems. Material, processes and design technology advances must be undertaken to sustain an effective defense capability and to maintain U.S. dominance in this critical technology area. The Microwave and Analog Front End Technology (MAFET) program is the only DoD effort directed at significantly reducing non-recurring costs for military microwave/millimeter wave sensor systems through improved computer aided design capabilities. It will provide urgently needed improvements in the performance and affordability of microwave and millimeter wave components. The MAFET program addresses the essential foundation for all DoD systems and programs making use of microwave and millimeter wave solid state technology.

(U) Specifically, the MAFET program will provide the DoD with the state-of-the-art electronic systems that it needs to maintain its force multiplying capability. The program will: (1) reduce design time and cost for every RF system being developed or upgraded through an improved microwave/millimeter wave design environment; (2) break the very expensive and time-consuming current practice of design-build-test--redesign-rebuild-retest; (3) put in place repeatable, robust processes to produce high frequency components; (4) make strategic investments in critical passive, packaging and integrated circuits devices needed for millimeter wave systems; and (5) investigate revolutionary solutions to the long-standing problem of insufficient power in solid-state radar and communications transmitters.

(U) **Program Accomplishments and Plans:**

(U) FY 1995 Accomplishments:

- Began implementation of microwave/millimeter wave computer aided design (CAD) environment that will reduce non-recurring chip/module/system costs by providing improved design, simulation capabilities. This task included enhancement of CAD tools specifically needed for microwave and millimeter wave circuit use (not

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-06

digital circuit design tools which are different), tool set integration, needed circuit and module model development, and work on the needed Microwave Hardware Description Language (MHDL). ($9.5M)

- Initiated advanced sensor technology development programs in the areas of fabrication technology, devices and circuits, packaging and passive components, millimeter wave test, and multichip assembly (MCA) foundries. ($10.0M)

(U) FY 1996 Program:

- Continue microwave/millimeter wave computer aided design (CAD) environment with quantitative demonstration of ability to reduce time and cost of producing microwave and millimeter wave products. Continue development and implementation of Microwave Hardware Description Language (MHDL). ($8.6M)
- Continue development of advanced sensor technology with demonstrations of improved performance coupled with cost savings. Demonstrate state-of-the-art millimeter wave probes. ($25.6M)
- Select most appropriate system application areas and begin demonstration tasks that will allow quantitative assessment of subsystem and system performance improvements and cost savings resulting from Microwave and Analog Front End Technology (MAFET) activities. Begin benchmark development and assessment of design tool advances. ($3.1M)
- Develop novel concepts and methodologies for high-power, ultra-low-cost, all-solid-state microwave sources and high millimeter wave sources. ($3.2M)

(U) FY 1997 Program:

- Continue microwave/millimeter wave computer aided design environment development with implementation of advanced microwave/millimeter wave CAD tools and integrated tool sets and implementation of improved models. Conduct assessment and demonstration of design environment effectiveness through quantitative assessment of benchmarking metrics. Continue development and implementation of MHDL. ($15.2M)
- Complete advanced sensor technology developments in the area of millimeter wave test. In addition demonstrate: (1) millimeter wave InP high electron mobility transistor (HEMT) monolithic microwave integrated circuits (MMICs) with high yield; (2) low cost, high Indium-content field effect transistor (FET) materials on gallium arsenide; (3) microwave and millimeter wave device arrays; (4) advanced mixed signal chips for highly integrated frequency synthesizers; (5) low cost MMIC components for electronic warfare transmitter arrays; (6) miniaturized microwave and millimeter wave ferrite circulators; (7) automated millimeter wave load pull test station; and (8) on-wafer known good die test station. Continue development of remaining advanced sensor technology with demonstrations of improved performance coupled with cost savings. ($20.5M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-06

- Provide quantitative demonstrations of performance improvements and cost savings achieved through MAFET program activities for selected, critical system applications. ($5.0M)
- Begin development of all-solid-state X-band source with high output power and low fabrication cost. ($7.2M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	22.3	50.7	52.9
Appropriated	20.5	42.6	N/A
Current Budget	19.5	40.5	47.9

(U) **Change Summary Explanation**:

FY 1995 Change due to minor program repricing.
FY 1996 Decrease due to reprogramming action in support of Bosnia and internal program reprioritization.
FY 1997 Decrease reflects revised program reprioritization.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan	Milestones
Jun 96	Standard model format for foundries; benchmark of baseline system.
Jul 96	Fabricate and test InP millimeter wave integrated circuits.
Mar 97	Standard for simulator and design environment interoperability.
Mar 97	Produce broadband electronic warfare multichip assemblies.
Jun 97	Demonstrate millimeter wave test probes and automated on-wafer test station.

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E

COST *(In Millions)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Centers of Excellence MT-07	35,381	17,056	14,000	0	0	0	0	0	N/A

(U) **Mission Description**: This project provides funding for Centers of Excellence including the Robert C. Byrd Institute for Advanced Manufacturing at Marshall University, the Focus: Hope National Center for Advanced Technologies (NCAT) and the Center for Computing Excellence at the Greater Philadelphia Consortium. The purpose of these Centers is to demonstrate, deploy and provide advanced manufacturing technology to significantly reduce unit production and life cycle costs, improve product quality, and deploy manufacturing training systems.

(U) The Institute for Advanced Flexible Manufacturing provides both a teaching factory and initiatives to local area industries to utilize computer-integrated manufacturing technologies and managerial techniques to improve productivity and competitiveness. The National Center for Advanced Technology (NCAT) is a component of the Focus: Hope Project whose purpose is to train technicians/engineers in advanced manufacturing processes and methods, demonstrate state-of-the-art flexible manufacturing and serve as a testbed for emerging manufacturing research.

(U) This project also includes funding in FY 1995 for the U.S.-Japan Management Training Program whose purpose is to build a growing infrastructure of American scientists and engineers with knowledge about the Japanese R&D enterprise and provide training in the Japanese language.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Completed the installation of the planned manufacturing neighborhoods at NCAT. ($13.0M)
- Continued the on-going technology development programs at the Institute for Advanced Flexible Manufacturing which includes technology evaluation, research into dual-use flexible manufacturing and technology transfer to local business. ($4.0M)
- Established a Regional Consortium for Advanced Education and Training Technologies which will provide for the development of computer software education and training technologies required to further adult training in advanced technology jobs critical to the defense industry. It will also focus on the retraining of defense personnel for industry jobs. ($9.6M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-07

- Created eleven centers of excellence to support students, researchers, and executives to understand Japan's manufacturing infrastructure, culture and language. ($8.8M)

(U) FY 1996 Program:

- Develop, demonstrate and evaluate new technologies for insertion and transfer to manufacturing centers and industry, with a focus on small- to medium-sized manufacturing companies. ($7.1M)
- Develop software to integrate 3D computer models with numerically controlled machine tools, and demonstrate its production capability. ($7.0M)
- Demonstrate an electronic (digital) library in the context of education and training of machinists. ($3.0M)

(U) FY 1997 Program:

- Continue the on-going technology development that includes technology evaluation, research into dual-use flexible manufacturing and technology transfer to local business at the Institute for Advanced Flexible Manufacturing. ($4.0M)
- Continuing development and demonstration of software to integrate computer models with numerically controlled machine tools. ($6.0M)
- Continue efforts to demonstrate a digital library to enhance the education and training of machinists. ($4.0M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	38.4	23.6	19.9
Appropriated	25.0	18.8	N/A
Current Budget	35.4	17.1	14.0

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-07

(U) **Change Summary Explanation**:

FY 1995 Increase reflects congressional direction to fund the Northeast Consortium.
FY 1996 Decrease reflects Bosnia reprogramming action and reduction to the U.S.-Japan Management Training Program.
FY 1997 Decrease due to completion of the U.S. - Japan Management Training Program, and the addition of the Advanced Flexible Manufacturing Program.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan	Milestones
Oct 96	Develop, demonstrate and evaluate technology insertion and technology transferred to medium and small manufacturing companies.

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Manufacturing Technology Applications MT-08	47,692	66,092	34,051	33,455	25,000	21,951	0	0	N/A

(U) **Mission Description:** Future military systems will be affordable only if the manufacturing process is considered as an integral part of product design, production takes place in flexible, multi-product factories, and if advanced manufacturing technology is combined effectively with advanced business practices. This program focuses on demonstrations of process technology combined with innovative industrial practices, and will measure the improvements in cost, schedule and quality achievable in key defense product areas. Three major initiatives are included in the FY 1995-1998 program: Affordable Multi-Missile Manufacturing (AM3); Agile Manufacturing Pilot Programs; and the DARPA/Tri-Service Flexible Interferometric Fiber Optic Gyroscope (IFOG) Manufacturability Program.

(U) The Affordable Multi-Missile Manufacturing (AM3) program is an Advanced Technology Demonstration initiated in FY 1995. The objective of AM3 is to demonstrate the feasibility of 25-50% reductions in the unit cost of tactical missiles, both in ongoing missile production programs and in new missiles and major modifications. This will be accomplished by teams of missile prime contractors, component suppliers and manufacturing equipment and software vendors who develop and demonstrate the combined effects of advanced design, manufacturing, assembly systems and processes, missile value engineering changes, and acquisition reform and business practice innovations. A major technical theme is to achieve economies across a mix of missiles to compensate for the decline in individual missile quantities. Demonstrations will be conducted in the design and manufacture of components and guidance and control/seeker assemblies for multiple missiles, including R&D and production programs.

(U) Agile Manufacturing is an industry-developed vision for 21st century manufacturing, which focuses on the ability to thrive in an environment of changing product technologies, customer demands, and development and production team members. This new paradigm is ideally suited to the needs of defense manufacturing in the future. Agile Manufacturing Pilot Programs are structured to evaluate the manufacturing enterprise concepts and enabling technology required for agility on and above the factory floor. Since over 50% of the cost of weapon systems is attributable to components from lower tier suppliers, the major emphasis is on tightly integrating the supplier chain and other elements of the manufacturing enterprise.

(U) Interferometric Fiber Optic Gyroscopes (IFOG) are emerging as preferred technology for future military and commercial inertial navigation applications. The emphasis of the IFOG Manufacturability Program is on achieving the design and manufacturing flexibility required to make low volume Defense components economically viable when compared

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE Technology 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-08

to high volume commercial production. This program will develop the large throughput robotic assembly, packaging and testing technologies necessary to fabricate navigation-grade (0.01 deg/hr) Interferometric Fiber Optic Gyroscopes (IFOGs) at less than $1,500 per axis as a goal. This will enable affordable, accurate (1nm/hr) inertial navigators for use during extended periods of Global Positioning System (GPS) signal outage due to enemy jamming. Flexible manufacturability enables, from the same production line, fabrication of navigation grade, military tactical grade (0.1 - 1.0 deg/hr) IFOGs and lower performing (> 1 deg/hr) commercial IFOGs. Example technology development areas include: (1) low loss, low reflectivity, polarization-preserving optical connectors between optical fiber subassemblies, optical sources, detectors and miniature integrated optical circuits; (2) rapid, precision coil winding machines; (3) geometrically stable, environmentally robust (temperature and vibration) packaging of critical optical subassemblies; and (4) automatic testing machines. Phase 1 will identify IFOG manufacturing process requirements for components, subassemblies and complete IFOG units. Phase 2 will demonstrate advanced manufacturing methods, controls and equipment. Phase 3 establishes and demonstrates a prototype automated, flexible IFOG manufacturing facility, transitioning the manufacturing processes and controls from Phase 2.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Initiated detailed functional design of the multi-missile enterprise, including definition of enabling tools and technology to be demonstrated in Phase 2, layout of the factories, definition of key organization interfaces and business practice improvements, and definition of proposed changes in missile design. ($11.4M)
- Initiated Affordable Multi-Missile Manufacturing (AM3) cost analysis and benefits measurement process, including predicted metrics for the enterprise, comparison to relevant benchmarks from military and commercial firms, assessment of impact on the target missile mix, and development of the validation plan for Phases 2 and 3. ($1.2M)
- Initiated Agile Manufacturing Enabling Technology Demonstrations of decision support, enterprise command and control, and flexible shop floor control. ($8.0M)
- Initiated Agile Manufacturing Advanced Business Process Demonstrations of activity based cost systems, agile workforce management systems, supplier chain management integration, and contracting approaches for instant partnerships. ($6.3M)
- Initiated Agile Manufacturing Pilot Programs and enterprise level demonstrations of technology and business practices in space launch vehicle manufacturing and in supplier chains for large metal castings. ($6.4M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE Technology 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-08

- Continued Agile Manufacturing industry forum activities to develop technical underpinnings and supporting data for agility concepts, education and tech transfer, and integration of demonstration results into an agility tool kit. ($5.0M)
- Defined advanced manufacturing processes for Interferometric Fiber Optic Gyroscopes (IFOG) components and subassemblies. ($.5M)
- Defined advanced architectures and manufacturing processes for IFOG units. ($8.9M)

(U) FY 1996 Program:

- Complete Affordable Multi-Missile Manufacturing (AM3) Phase 1, approve validation plans, and initiate Phase 2 demonstrations to assess and mitigate risks, including simulation and modeling, design and component-level manufacturing demonstrations, and qualification testing. ($14.6M)
- Competitive awards to research labs, universities and manufacturing system vendors for development of technology to fill gaps identified in AM3 Phase 1. ($1.0M)
- Continue AM3 technical integration activities, conduct independent evaluation of contractor cost savings analyses and complete initial set of benchmark comparison studies for the missile sector. ($1.5M)
- Complete Agile Manufacturing business practice demonstrations and documentation, insert results in Pilot Program testbeds, and disseminate results for DoD and industry implementation. ($6.4M)
- Complete Agile Manufacturing enabling technology demonstrations, initiate beta test in Pilot Programs, and transfer technology through the Industry Forum and through vendor products. ($9.2M)
- Complete Agile Manufacturing pilots in space launch vehicles and castings. ($9.0M)
- Complete Agile Manufacturing industry forum activities, including delivery of agility toolkit and knowledge base and transition to self-sustainment. ($5.0M)
- Develop and implement manufacturing processes for coil winding and optical components/subassemblies. ($4.1M)
- Complete IFOG architectures and begin to develop and implement manufacturing processes. ($15.3M)

(U) FY 1997 Program:

- Complete AM3 Phase 2 component-level validation demonstrations. ($4.3M)
- Downselect to two pilot enterprises for AM3 Phase 3, and initiate cost-shared implementation and demonstration of concepts and technology across the target missile mix. ($2.5M)
- Complete initial demonstrations of technologies to fill gaps identified in AM3 Phase 1, expand benchmarking studies, and continue technical integration and independent cost analysis. ($5.5M)
- Evaluate wound coils and packaged subassemblies for IFOG. ($4.7M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE Technology 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-08

- Continue to implement brassboard Interferometric Fiber Optic Gyroscopes (IFOG) unit manufacturing processes. ($15.5M)
- Initiate Phase 3 of IFOG program (e.g., procure long-lead items). ($1.6M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	54.7	78.9	91.2
Appropriated	48.7	67.3	N/A
Current Budget	47.7	66.1	34.1

(U) **Change Summary Explanation**:

FY 1995 Decrease due to minor repricing.
FY 1996 Decrease reflects inflation savings cited on reprogramming actions.
FY 1997 Decrease reflects completion of the Agile Manufacturing enabling technology, and repricing of the AM3 program.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan	Milestones
Apr 96	Define processes for packaging IFOG optical components (e.g. sources, detectors).
Apr 96	Establish IFOG unit architectures and baseline configurations.
Jul 96	Complete proof-of-concept of fiber pigtailing for integrated optics chips.
Apr 96	Approve validation plans and initiate AM3 Phase 2 contracts.
Sep 96	Complete Agile Manufacturing enabling technology and business practice demos.
Oct 97	Complete IFOG advanced coil winding machinery.
Oct 97	Demonstrate winding of test coils with advanced coil winding machinery.
Jul 97	Complete AM3 Phase 2 demos, downselect to two contractors for Phase 3.
Aug 97	Demonstrate production of novel wavelength stabilized IFOG light source.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE Technology 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-08

Feb 98 Demonstrate assembly of brassboard IFOG units.
Dec 99 Complete AM3 Phase 3 multi-missile manufacturing demos.

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Advanced Lithography MT-10	56,321	47,010	51,404	40,000	40,000	40,000	40,000	Continuing	Continuing

(U) **Mission Description:** Lithography technology has enabled the dramatic growth in microelectronics capability over the past three decades and microelectronics is a key to improved weapon system performance. The improved capabilities in semiconductor technology contribute to significant system gains in speed, reliability, cost, power consumption, and weight. Advanced microelectronics technology is essential for computing and signal processing throughout essentially all military systems, including command, control, communications, and intelligence, electronic warfare, and beam forming for radar and sonar. Further improvements in areas such as target recognition, autonomous guided missiles, and digital battlefield applications require microcircuits with smaller features to meet the operational speed, power, weight and volume constraints of these systems.

(U) Current microelectronics fabrication utilizes feature sizes of 0.35 microns. The Advanced Lithography Program emphasizes longer term research with expected high payoff in the fabrication of semiconductor devices with 0.1 micron feature sizes. These programs, including ion and electron projection, will develop technology for sub 0.1 micron features. Current programs in cross-cutting technologies (mask, stages, resists, metrology) and x-ray lithography will be completed in one - two years. The projection ion-beam and e-beam developments will demonstrate alpha tool versions late in the decade.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Developed mask technology and fabricated a perfect x-ray mask for 64 megabit memory. ($22.0M)
- Synchrotron stepper was installed at synchrotron. ($10.0M)
- 193 nm optical lithography was used to print 0.09 micron features. ($3.0M)
- Picosecond laser source for x-rays demonstrated 10% conversion efficiency with significant reduction of debris. ($4.0M)
- Formed the Proximity X-Ray Association and fabricated 0.1 micron logic with stage delays of 30 picoseconds. ($12.0M)
- Projection e-beam printed 0.15 micron features and space charge experiments were completed for projection ion beam. ($5.3M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-10

(U) FY 1996 Program:

- Demonstrate prototype projection electron-beam and ion-beam lithography lenses. ($10.0M)
- Demonstrate processing using x-ray lithography and point source development. ($23.0M)
- Develop alignment sub-assemblies and mask technology for 0.18 micron lithography system. ($14.0M)

(U) FY 1997 Program:

- Demonstrate stage control for lithography tools with 0.12 micron capability. ($6.0M)
- Demonstrate breadboard subsystems of electron-beam and ion-beam projection lithography systems. ($14.0M)
- Fabricate devices and x-ray sources for 0.12 micron design rules. ($25.0M)
- Improve e-beam writing, inspect, repair, and processing for 0.12 mask capability. ($6.4M)

(U) **Program Change Summary:** *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	57.7	39.0	61.4
Appropriated	54.1	59.0	N/A
Current Budget	56.3	47.0	51.4

(U) **Change Summary Explanation:**

FY 1995 Increase necessary to satisfy commitments in ion-beam research.
FY 1996 This funding decrease is due to rescission of the Point Source X-Ray Lithography Program, ($11.0 million) and the Bosnia reprogramming action ($1.0 million).
FY 1997 Decrease reflects the descoping of projection systems, but continued research of advanced technologies.

(U) **Other Program Funding Summary Cost:** N/A

(U) **Schedule Profile:**

Plan	Milestones
Mar 96	Deliver prototype x-ray masks with 0.18 μm features.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-10

Jun 96 Demonstrate mask repair tool for masks with 0.15 micron features.
Sep 96 Fabricate devices with 0.18 micron features.
Jan 97 Demonstrate subsystems for mask writer for writing 0.18 µm features.
Mar 97 Demonstrate x-ray source suitable for x-ray prototype tool for 0.18 µm features.
Mar 97 Demonstrate stage control to 10 nm, suitable for 0.12 micron lithography tools.
Apr 97 Demonstrate breadboard (alpha) version of electron-beam lithography system.
Dec 97 Demonstrate alpha version of ion-beam lithography tool.

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Electronic Commerce Resource Centers MT-11	33,755	32,295	20,704	15,000	0	0	0	0	N/A

(U) **Mission Description:** The mission of this program is the transfer of electronic commerce (EC) technologies to small- and medium-size enterprises (SMEs) through a network of regional deployment centers. This mission is a subset of the overall DoD plans for Continuous Acquisition and Life-cycle Support (CALS) and for electronic commerce as part of Acquisition Reform. To reflect the focus on that subset, the program name was changed in FY 1994 from CALS Shared Resource Centers to Electronic Commerce Resource Centers (ECRCs). In transferring EC technologies to SME's, the ECRC technical vision is that manufacturing companies will move down a path of increasing EC capability that ranges from linking suppliers with customers, via electronic data interchange, to the establishment of virtual enterprises. An ECRC technology hub has been established to keep abreast of EC technologies and to ensure that technical consultants in the regional ECRCs are equipped with the latest information and training on EC technologies.

(U) **Program Accomplishments and Plans**:

(U) FY 1995 Accomplishments:

- Reestablished Orange, TX ECRC under management of Lamar University (Congressional direction). ($2.0M)
- Continued Regional ECRC activities; expanded the depth of specialized ECRC expertise through technology demonstration projects; establish and executed a plan for support of the DoD Electronic Commerce in Contracting initiative; convened a series of DoD Prime/supplier chain forums and followed up with small- and medium-size suppliers to implement electronic commerce transaction capabilities. ($18.8M)
- Conducted technology hub operations with initiatives for Electronic Commerce Testbed and for advances in tools needed for development of Standard for Exchange of Product Data (STEP) application protocols. ($7.0M)
- Competitive awards to ECRCs/university/business teams were awarded for near-term innovations in electronic commerce practices. ($6.0M)

(U) FY 1996 Program:

- Follow-on awards to current ECRC integrators to continue ECRC network of sites for nationwide delivery of education, training, and technical support services (Congressional direction). ($23.0M)
- Continue Technology Hub operations with initiatives for Electronic Commerce (EC) Testbed, and for advances in tools needed for development of STEP applications. ($10.0M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-11

(U) FY 1997 Program:

- Continue operation of nationwide network of centers, and expand linkage to Defense Logistics Agency activities. ($20.7M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	38.3	34.2	20.6
Appropriated	33.8	33.3	N/A
Current Budget	33.8	32.3	20.7

(U) **Change Summary Explanation**:

FY 1996 Decrease is due to Bosnia reprogramming.
FY 1997 Increase due to minor program repricing.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan	Milestones
Sep 96	Demonstrate value of networked access to ECRC services; train 3000 companies to implement electronic commerce.
Sep 97	Complete transition of ECRC activities to Defense Logistics Agency.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E

COST *(In Millions)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Microelectromechanical Systems (MEMS) MT-12	(23,962)*	30,015	54,800	65,060	66,549	24,281	0	0	N/A

*The FY 1995 MEMS program was funded from Projects MT-04 and ES-01; the FY 1996 program was funded in MT-12 and ES-01.

(U) **Mission Description**: The Microelectromechanical Systems (MEMS) program is a broad, cross-disciplinary initiative to develop an enabling technology that merges computation with sensing and actuation to realize new systems for both perceiving and controlling weapons systems, processes and battlefield environments. Using fabrication processes and materials similar to those that are used to make microelectronic devices, MEMS conveys the advantages of miniaturization, multiple components, and integrated microelectronics to the design and construction of integrated electromechanical systems. The MEMS program addresses the issues ranging from the scaling of devices and physical forces to new organization and control strategies for distributed, high-density arrays of sensor and actuator elements.

(U) The MEMS program has three principal objectives: the realization of advanced devices and systems concepts; the development and insertion of MEMS products into DoD systems; and the creation of support and access technologies to catalyze a MEMS technology infrastructure. These three objectives cut across a number of focus application areas to create revolutionary military capabilities, make high-end functionality affordable to low-end systems, and extend the operational performance and lifetimes of existing weapons platforms. The major technical focus areas for the MEMS program are: 1) inertial measurement; 2) fluid sensing and control; 3) electromagnetic and optical beam steering; 4) mass data storage; 5) chemical reactions on chip; 6) electromechanical signal processing; 7) active structural control; 7) analytical instruments; and 8) distributed networks of sensors and actuators.

(U) Accomplishments to date include: a wind-tunnel test of an integrated MEMS sensor and actuator array distributed along the leading edge of a model aircraft wing creating rolling moments of sufficient strength to control aircraft flight, pointing the way to future fighter aircraft with advanced maneuverability unattainable using conventional, large and discrete control surfaces; a demonstration of a MEMS-based accelerometer capable of surviving and operating in the near 100,000 G accelerations generated by firing artillery shells, making possible affordable guidance systems to what are presently unguided munitions and increasing both their effectiveness and life cycle costs; and the establishment of a regularly scheduled, shared, MEMS fabrication service for domestic DoD, commercial and academic users. The service has lowered barriers to access and has allowed hundreds of researchers, students and industrial users, nearly half for the first time, to inexpensively and rapidly fabricate MEMS devices.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-12

(U) **Program Accomplishments and Plans:**

(U) FY 1995 Accomplishments:

- Demonstrated and multi-site evaluated a sensor cluster for environmental monitoring; multi-device chip run with over twenty different devices (including accelerometers, gyroscopes, flow-sensors, and resonators) fabricated from a single, common, high-volume surface micromachining process; successful operation of a vertical-wall silicon carbide reactor to deposit sensor-grade films over multiple, 100 mm wafers; inserted and tested MEMS inertial measurement devices in projectile munitions. ($10.2M)
- Demonstrated single-crystal, micromachined tunneling tips with integrated, three-dimensional positioning actuators; prototype multiple-component conformal MEMS sensing and actuating arrays applied to delta-wing model and operated in wind-tunnel tests; demonstrated organization and processing of signals from sensors distributed across control surfaces of underwater vehicles. ($4.4M)
- Disseminated and continued development of a multi-use design library for MEMS devices and systems; dissemination of CAD tools that are coupled to shared fabrication services; completion and continued offering of ninth shared surface micromachining fabrication run reaching over 350 users in the government, industry and academia. ($2.0M)
- Demonstrated high-yield, high-uniformity fabrication processes for microelectromechanical system (MEMS) devices and merged MEMS with related fabrication technologies in optics/optoelectronics. Initiated low-bandwidth, large-scale MEMS-based sensor networks. ($6.8M)

(U) FY 1996 Program:

- Achieve factor of 3-5x increase in electronics-to-mechanics integration ratios with new fabrication processes; begin development of related information-driven and fault-tolerant designs for devices; begin incorporation of extreme condition materials into sensor and actuator designs. ($7.0M)
- Achieve 200-300 mechanical components/sq. cm systems densities with associated increases in both process yields and device performance uniformities; begin exploration of new organization and control strategies for multiple, heterogeneous and distributed MEMS components; continue development of complete and stressing MEMS systems demonstration projects in areas such as fluid vortex control, adaptive optics, combustion control and atomic-resolution mass-data storage. ($17.0M)
- Extension of distributed shared fabrication services to enable process experimentation; continue development of fabrication, packaging and metrology tools to address devices and systems developments; expand available set of shared fabrication processes and associated CAD tools and design libraries. ($6.0M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-12

(U) FY 1997 Program:

- Achieve additional factor of 5-10x increase in electronics-to-mechanics integration ratios; explore space of related device designs and architectures enabled by order-of-magnitude increase in integration ratios including electromechanical signal processing elements and radio-frequency components; continue development of fault-tolerant and parallel designs including low-noise, low-drift multi-axis accelerometers and gyroscopes; demonstration of extreme temperature and pressure sensor function in operational environments. ($10.7M)
- Achieve 400-500 mechanical components/sq. cm systems densities with integrated or hybrid fabrication/assembly techniques; demonstrate MEMS applications using massively parallel MEMS components; initiate new dual-use areas including analytical instruments, precision assembly, on-demand structural strength enhancement and air-vehicle aerodynamic control; begin creation of shared testbed for development and validation of new organizational and control strategies for large-scale, distributed MEMS. ($23.2M)
- Begin transition of mature fabrication services to self-sufficiency; demonstrate scalable distributed fabrication services for MEMS process experimentation; continue development of MEMS-specific unit processes and associated processing equipment; continue the extension of simulators to address the modeling and coupling of multiple physical forces encountered in MEMS applications; continue dissemination and validation of CAD tools and design libraries. ($8.9M)
- Initiate plans to develop on-chip integrated microfluidic systems for improved detection and control of molecular reactions with emphasis on the development of new materials and control of reactions. ($12.0M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget*	0	31.0	42.8
Appropriated	0	30.2	N/A
Current Budget	0	30.0	54.8

*MEMS funding was previously included in Project MT-04 and ES-01.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-12

(U) **Change Summary Explanation**:

FY 1996 Decrease reflects reprogramming effort in support of Bosnia.
FY 1997 Increase reflects program in microfluidic systems.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan	Milestones
Feb 96	Condition-based maintenance tests.
Jun 96	MEMS-based weapons safeing and arming tests.
Aug 96	Aerodynamic control of model airplane flight with distributed MEMS.
Oct 96	Microcombustion heat exchanger operation.
Mar 97	Navigation-grade inertial measurement and guidance devices.
Jun 97	VGA-resolution monochrome grating light-valve display.
Sep 97	25k Tracks/in magnetic recording with dual-stage actuators.
Jan 98	Self-sufficiency of mature shared fabrication services.
Jun 98	Controlled chemical reactions and processing on chip.
Jan 99	Atomic-resolution data storage using precision, multiple read/write structures.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Maritime Technology, PE 0603746E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Shipbuilding Technology MR-01	40,418	47,196	37,408	50,000	0	0	0	0	N/A

(U) **Mission Description:** The shipbuilding technology program is designed to preserve the shipbuilding segment of the defense industrial infrastructure by improving competitiveness of the U.S. shipbuilding industry through advanced technology applications. For the Defense Department, a competitive shipbuilding industry will optimize Navy ship acquisition reform and facilitate the Department's objective for affordable Navy ships. The goal of the DoD Acquisition Reform program is to take advantage of the best commercial practices of industry and thereby achieve cost reductions of the ships and systems it purchases. The government's attempt at acquisition reform, as it applies to ship acquisition, could fall short if U.S. shipyards are not commercially competitive. Having operated exclusively in a protected domestic market, the U.S. shipbuilding industry has not implemented the best commercial processes necessary to compete in the international arena or to build affordable Navy ships. The key for acquisition reform is for the U.S. shipbuilding industry to attain global commercial competitiveness.

(U) The shipbuilding technology program is a two phased effort that will provide products and infrastructure for both the near and long term. The near term effort will enhance international competitiveness through identification and development of competitive build strategies that would be implemented in the next 2-3 years, and the development of a portfolio of U.S. ship designs for the international marketplace. This effort will be enhanced by developing an infrastructure that would include the implementation of electronic communications and commerce throughout the industry, and by participating in an industry-wide forum for problem solving on a technical level.

(U) The long term effort will include the infusion of innovative product technologies and process improvements that will bring the capabilities of the U.S. shipbuilding industry above those of foreign shipyards. This will result in a larger share of the international market, and in a self-sustaining, highly efficient U.S. shipbuilding industry.

(U) **Program Accomplishments and Plans:**

(U) FY 1995 Accomplishments:

- Continued development of advanced shipbuilding strategies and affordable designs commenced in FY 1994. ($16.6M)
- Initiated additional shipbuilding strategies and affordable design initiatives. ($6.5M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Maritime Technology, PE 0603746E, Project MR-01

- Initiated advanced technology development initiatives to improve ship production processes and/or ship/shipboard systems operations. ($13.6M)
- Initiated Phase II of National Shipbuilding Network's (NSnet's) infrastructure development. ($.6M)
- Completed National Maritime Technology Needs study. ($.2M)
- Initiated study to determine how best to integrate competitive commercial practices for affordable Naval ship construction. ($.2M)
- Commenced development of advanced shipbuilding capabilities demonstration. ($.5M)
- Commenced development of distributed simulation, Hypervelocity Interceptor Technology demonstration, and Over-the-Horizon (OTH)/Early Detection Technology for Ship Self Defense. ($1.2M)
- Demonstrated Initial Human Computer Interaction Suite for Scene Understanding. ($1.0M)

(U) FY 1996 Program:

- Complete all shipbuilding strategy development initiatives and new ship designs begun in prior years. ($14.1M)
- Complete advanced technology development initiatives started in FY 1995. ($7.4M)
- Establish a National Shipbuilding Consortium. ($.6M)
- Commence Electronic Commerce Computer Integrated Enterprise for Maritime community development. ($3.7M)
- Continue to improve and expand NSnet. ($.9M)
- Commence new initiatives for advanced shipbuilding strategies and new commercial designs. ($4.5M)
- Commerce new initiatives for advanced technologies to radically improve ship production processes and products. ($9.4M)
- Investigate Applicability of Advanced Materials to hull construction. ($2.7M)
- Develop application protocols for ship design and shipboard automation. ($3.9M)

(U) FY 1997 Program:

- Initiate additional advanced technology developments for improving ship production processes and products. ($8.4M)
- Complete advanced technology developments started in FY 1996. ($8.4M)
- Continue to improve and provide support for NSnet. ($.7M)
- Expand Electronic Commerce and Computer Integrated Enterprise. ($6.9M)
- Support National Shipbuilding Consortium. ($1.0M)
- Complete advanced shipbuilding strategies and commercial ship design initiator. ($12.0M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Maritime Technology, PE 0603746E, Project MR-01

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	52.0	49.7	49.7
Appropriated	38.8	48.1	N/A
Current Budget	40.4	47.2	37.4

(U) **Change Summary Explanation**:

FY 1995 Increase ($+1.6 million) to partially restore rescissioned Ship Self Defense funds that could not be recovered.
FY 1996 Decrease due to inflation savings cited on reprogramming actions.
FY 1997 Decrease due to revised program requirements.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**:

Plan	Milestones
Dec 95	Formation of national shipbuilding consortium focused on the international competition.
Jan 96	Two MARITECH projects begun in FY 1994 resulted in commercial orders for 11 ships (6 for export).
Apr 96	Commence new initiative for Advanced Technologies to radically improve ship construction processes in the U.S. to surpass foreign competition.
Sep 96	Complete development of 19 new ship designs for the international commercial marketplace along with strategies for competitive construction.
Sep 97	Complete development of 15 process and product technological innovations focused on aiding the U.S. shipbuilding community to compete internationally.
Sep 97	Complete 9 additional ship designs for the international commercial marketplace.

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Joint Advanced Strike Technology, PE 0603800E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Joint Advanced Strike Technology JA-01	*(37,653)	29,781	78,400	23,922	0	0	0	0	169,756

*Funded under JAST program, PE 0603800N. Provided directly to DARPA from JAST.

(U) **Mission Description:** The Joint Advanced Strike Technology (JAST) Program is the focal point for defining affordable next generation strike aircraft weapon systems for the USN, USMC, USAF, and allies. Program emphasis is on facilitating the evolution of fully validated and affordable joint operational requirements, and demonstrating cost leveraging technologies and concepts to lower risk prior to entering engineering and manufacturing development (E&MD) of the JSF in FY 2001. The JAST Program is a joint program with no executive Service. Beginning in FY 1995, the Navy and Air Force each provide approximately equal shares of annual program funding. DARPA's Advanced Short Take Off Vertical Landing (ASTOVL)/Conventional Take Off and Landing (CTOL) Common Affordable Lightweight Fighter (CALF) project (previously known as ASTOVL) was integrated with the JAST program by FY 1995 legislation. DARPA contributes funding for the JAST Program in FY 1996 under this new program element. The US/UK international collaborative CALF Program conceived by DARPA was investigating a revolutionary approach for melding advanced technology, multi-service commonality, and improved business practices directed toward demonstrating an affordable, capable replacement for the F-16, F/A-18, and AV-8B. DARPA is bringing this insight and experience to bear in integrating the structure and philosophy of the CALF program within the JAST framework. The DARPA program manager now is serving as a Director within the JAST program organization. This ensures that DARPA's expertise in ASTOVL technologies, streamlined acquisition, and rapid prototyping are brought to bear in the JAST technology demonstration program.

(U) **Program Accomplishments and Plans:**

FY 1995 Accomplishments:

- Initiated large scale wind tunnel testing and large scale propulsion system tests for the Shaft Coupled Lift Fan Concept. ($16.7M)
- Completed large scale propulsion system tests for the Gas Coupled Lift Fan Concept. ($9.5M)
- Initiated large scale powered model system tests for the Direct Lift Concept. ($8.5M)
- NASA Test Support provided in the form of model instrumentation and special facility provisions to accommodate large scale models. ($3.0M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Joint Advanced Strike Technology, PE 0603800E, Project JA-01

(U) FY 1996 Program:

- Complete critical technology validation program for the Direct Lift and Shaft Coupled Lift Fan Concepts. ($7.7M)
- Commence Preliminary Demonstration Design Propulsion and JAST Competitive Engine efforts. ($18.7M)
- Commence concept definition and design research for weapon system concept for a tri-service family of aircraft. ($3.4M)

(U) FY 1997 Program:

- Continue ground and flight demonstrations and concept refinement for the tri-service family of aircraft. ($23.4M)
- Continue Preliminary Demonstration Design Propulsion system and JAST Competitive Engine efforts. ($55.0M)

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	37.7*	30.7	80.9
Appropriated	N/A	29.9	N/A
Current Budget	37.7*	29.6	78.4

*Funds appropriated to JAST program, PE 0603800N and sent directly to DARPA.

(U) **Change Summary Explanation**:

FY 1996 Decrease reflects Bosnia reprogramming.
FY 1997 Decrease reflects minor program repricing.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Joint Advanced Strike Technology, PE 0603800E, Project JA-01

(U) **Other Program Funding Summary Cost**: *(In Millions)*

	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
PE 0603800F	83.8	81.2	263.8	431.1	458.5	238.9	18.8	0	1,576.10
PE 0603800N	98.3	81.2	246.8	421.8	457.3	239.0	18.9	0	1,563.30
United Kingdom*	0.0	14.0	71.0	55.0	20.0	20.0	20.0	0	200.0

*Includes $37.819 shown in JA-01 Funding Summary for this project.

(U) Related RDT&E: PEs 0604800N & 0604800F: Milestone II for a joint follow-on engineering & manufacturing development (E&MD) program for the Joint Strike Fighter (JSF) is planned in FY 2000. The follow-on program will develop a tri-service family of aircraft from concepts proven under the JAST Program, incorporating affordable technologies transitioned from the JAST Program.

(U) **Schedule Profile**:

Planned	Milestones
Jan 96	Complete Large Scale Propulsion Model Testing.
Oct 96	Award concept demonstration contract.
Mid 97	Complete preliminary design of Concept Demonstration Aircraft.
Early 98	Complete detailed design of Demonstration Aircraft.

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Dual Use Applications Program, PE 0603805E

COST *(In Thousands)*	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Dual Use Applications Programs GC-01	0	0	250,000	195,000	195,000	195,000	195,000	Continuing	N/A

(U) **Mission Description:** This is a new program which builds on the dual-use successes of past programs which demonstrated a highly successful, fundamentally new and effective approach to the acquisition of technology for the DoD--one based on entrepreneurial leverage of superior commercial technologies using cost sharing and government/industry partnership. Each of the almost 130 military development projects established using this approach validates the advantage of some new commercial technology or business techniques applied to DoD. All were selected and managed outside of the traditional defense acquisition mold; most use completely new legal instruments and authorities.

(U) The major direct benefit of dual use to the military is its access to superior technologies that are currently restricted to commercial use. Other benefits include leveraged funding (an opportunity for cost sharing of at least 50% with the commercial partner), attracting new players (other than the traditional military contractors), commercialization (e.g., cost reduction), and the efficiencies of integrating military and commercial industrial processes. There is a particular emphasis on system upgrades, rather than the expensive development of new systems. Upgrading demands continuity of the manufacturing and service base as well as attention to protocols and standards to allow the introduction of new components, software or add-on units. While conventional defense industry has had problems with these activities, dual use exploits the ability of the commercial world to accomplish them.

(U) The mission of the Dual Use Applications Program (DUAP) is not to continue the past experiment, but rather to move ahead by embedding these new ideas into the Services as a new norm. DUAP is built around a three-year process of transition designed to firmly root the principles of expanding dual-use leverage throughout the DoD, not just at the R&D level. Projects will be solicited as government/industry partnerships and selected to meet Service needs. They will be managed by the Services under the new authorities and methods, along a clear path for incorporation of those technologies in deployable systems.

(U) The responsibility for the implementation of this new initiative is assigned to the Joint Dual-Use Project Office (JDUPO). The JDUPO was established on December 9, 1995, by a Memorandum of Understanding (MOU) between the Science and Technology Executives of the Army, Navy, and Air Force, the Director of DARPA and the Director, Defense Research and Engineering (DDR&E). The mission of this office is to make DoD-wide, military-focused investments in development of dual-use technologies. The joint office will ensure that the dual use technology strategies developed

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Dual Use Applications Program, PE 0603805E, Project GC-01

will be implemented by the Military Departments and the technology products will directly address the needs of its customer, the warfighter. The JDUPO is under the directorship of DARPA during FY 1997. Beginning with FY 1998, this program will transition to the Military Departments under the direction of the DDR&E.

(U) Use of innovative, non-procurement agreements such as Other Transactions and Cooperative Agreements offer a more creative mechanism between the government and the performing consortium than conventional contract practices. These type of agreements allow a commercial-like business practice which is conducive to a dual-use effort affording both parties the flexibility of negotiating the essential points without the restrictive terms of the FAR and other regulations directed at procurement type purchases. These non-procurement agreements will be an integral part of this dual use program.

(U) **Program Accomplishments and Plans**:

(U) FY 1997 Program:

- Technology thrusts for this program will be jointly selected and built around the following criteria: (1) an explicit, identified need from a military user or systems office; (2) the potential of dual-use as an efficient approach to meeting that need; and (3) a viable transition plan for incorporation of the technology into a military system.
- A set of the most pressing military needs which are best addressed through the strategy of dual use has been identified. Although the final selection process is not yet complete, the following is representative:
  - eliminate limitations on battlefield electronics (communications, computers, night visions scopes, etc.) due to lack of available portable energy;
  - lower maintenance cost and increase reliability of military platforms such as the Advanced Amphibious Assault Vehicle (AAAV), the M1A1 (Abrams tank), and the Landing Craft Air Cushion Vehicle;
  - reduce development, procurement and operating costs of sensor components, sensor architectures, and multi-sensor integration for military operations such as reconnaissance, perimeter monitoring, guidance, target detection;
  - reduce the probability of acoustic detection for military platforms;
  - protect the combat soldier against chemical, biological, and electromagnetic threats;
  - increase reliability and system survivability through use of high power, high temperature electronics;
  - increase the ability of the military to manipulate, exchange, convey, protect and, most importantly, rapidly understand battlefield information;
  - reduce structural weight in aircraft, vehicles and ships at an affordable cost; and

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Dual Use Applications Program, PE 0603805E, Project GC-01

- enable secure, multimedia wireless communications to the soldier on the battlefield.

- This set is in various stages of evaluation and is being thoroughly reviewed by the Military Departments and DARPA. Specific technology thrusts will be built around a subset of these needs. Upon approval of the final selections by the Joint Steering Committee, a BAA will be published inviting proposals.
- Based on the competition announcement, scheduled to be printed not later than the fourth quarter of FY 1996, proposals responding to the selected technology thrusts will be chosen during the first quarter of FY 1997. Technical and administrative management of these projects will be assigned to a military organization with ties to expected users. The Military Service representatives within the JDUPO will actively pursue, in an on-going fashion, continued and working relationships between the Service end users and the developers to ensure complete military compatibility with final products within the goals of the program (performance, affordability, and accessibility). Projects will be performed primarily with industry and/or industry teams with support from universities and military laboratories as appropriate.
- During the third quarter of FY 1997, new technology thrusts for FY 1998 will be chosen following the same procedures outlined in the MOU.

(U) **Program Change Summary:** *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	N/A	N/A	N/A
Appropriated	N/A	N/A	N/A
Current Budget	N/A	N/A	250.0

(U) **Change Summary Explanation:**
FY 1997 Program initiated.

(U) **Other Program Funding Summary Cost:** N/A

(U) **Schedule Profile:** N/A

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: March 1996
APPROPRIATION/BUDGET ACTIVITY: RDT&E, Defensewide; BA 6 RDT&E Management Support	R-1 ITEM NOMENCLATURE: Management Headquarters (R&D), PE 0605898E

COST (In Thousands)	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Management Headquarters MH-01	29,736	34,099	36,369	37,315	38,486	39,147	39,991	Continuing	Continuing

(U) **Mission Description:** This program element is budgeted in the Management Support Budget Activity because it provides funding for the administrative support costs of the Defense Advanced Research Projects Agency. The funds provide for personnel compensation for civilians as well as costs for building rent, physical and information security, travel, supplies and equipment, communications, printing and reproduction. In addition, funds are included for reimbursing the Military Services for administrative support costs associated with contracts undertaken on the Agency's behalf.

(U) **Program Accomplishments and Plans:**

(U) FY 1995 Accomplishments:

- Funding under this program element in FY 1995 supported management and administration for the RDT&E programs assigned to DARPA. The majority of the funds were required for the pay of personnel who operate the Agency. The funding level reflects the rental costs associated with the expansion of office space, and the related support requirements.

(U) FY 1996 Program:

- DARPA will continue the management and administrative support efforts for headquarters at approximately the same level as FY 1995. Increases reflect annualization of increased support in FY 1995.

(U) FY 1997 Program:

- DARPA will continue the management and administrative support efforts for headquarters at approximately the same level as FY 1996. The funding level reflects increased payroll requirements.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: March 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 6 RDT&E Management Support	R-1 ITEM NOMENCLATURE Management Headquarters (R&D), PE 0605898E, Project MH-01

(U) **Program Change Summary**: *(In Millions)*

	FY 1995	FY 1996	FY 1997
President's Budget	30.2	32.6	33.9
Appropriated	28.7	32.6	N/A
Current Budget	29.7	34.1	36.4

(U) **Change Summary Explanation**:

FY 1997 Increases reflect minor repricing due to pay raises and personnel mix changes.

(U) **Other Program Funding Summary Cost**: N/A

(U) **Schedule Profile**: N/A